Phase 5: Regulatory Action Selection

Final Project Report

Total Maximum Daily Loads for Pathogens in Soquel Lagoon Santa Cruz County, California

July 31, 2006

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1. PROJECT DEFINITION

1.1. Introduction

The Clean Water Act requires the State to establish a Total Maximum Daily Load (TMDL) for the Soquel Lagoon. A TMDL is required because this waterbody was identified as impaired for pathogens and was placed on the Federal 303(d) List. The Soquel Lagoon was placed on the 303(d) List for non-attainment of pathogen water quality objectives. Based on historic and recent data, concentrations exceeded the water quality objectives for fecal coliform (a pathogen indicator) that protect beneficial uses for water contact recreational use and shellfish harvesting[1]. Exceedance occurred during both wet and dry seasons. Staff concluded the causes of impairment were birds, rodents, and wildlife, sewer spills and leaks, lateral connections, storm drain discharges, homeless encampments, pets, and livestock. Staff proposed allocations for all sources and implementation actions for controllable sources.

Staff is proposing to remove the shellfish harvesting beneficial use in the Soquel Lagoon as part of this project. Supporting documentation is included in the Use Attainability Analysis contained in Appendix Four.

Clean Water Act Section 303(d) requires the State to establish TMDLs at levels that attain water quality objectives. The State must also incorporate seasonal variations and a margin of safety into the TMDL to account for any lack of knowledge concerning the relationship between load limits and water quality.

1.2. Listing Basis

According to the USEPA Protocol for Developing Pathogen TMDLs, "the numbers of pathogenic organisms present in polluted waters generally are few and difficult to isolate and identify, as well as highly varied in their characteristic and type." Therefore, scientists and public health officials typically choose to monitor nonpathogenic bacteria that are usually associated with pathogens transmitted by fecal contamination but are more easily sampled and measured. These associated bacteria are called indicator organisms. Indicator organisms indicate the potential presence of human and animal pathogenic organisms. When large fecal coliform populations are present in the water, it is assumed that there is a greater likelihood that pathogens are present. The *Water Quality Control Plan, Central Coast Region* (Basin Plan) uses fecal coliform concentrations as water quality objectives to represent pathogenic organisms.

The California Regional Water Quality Control Board, Central Coast Region (Water Board) placed the Soquel Lagoon on the 303(d) List of impaired waters in 1994. The Soquel Lagoon was listed based on Santa Cruz County Environmental Health data

[1] Staff is proposing to remove the shellfish harvesting beneficial use in the Soquel Lagoon.

indicating water quality objective violations in all years for which there was data from 1986 to 1994. Additional data collected between 1994 and 2005 still show impairment.

1.3. Beneficial Uses

The Basin Plan contains beneficial uses for the Soquel Lagoon. The Soquel Lagoon beneficial uses are: Contact and Non-contact Recreation (REC-1 and REC-2), Wildlife Habitat (WILD), Cold Freshwater Habitat (COLD), Migration of Aquatic Organisms (MIGR), Spawning, Reproduction, and/or Early Development (SPWN), Rare, Threatened, or Endangered Species (RARE), Estuarine Habitat (EST), Commercial and Sport Fishing (COMM), and Shellfish Harvesting (SHELL).

Water Board staff is proposing to remove the shellfish harvesting beneficial use in the Soquel Lagoon. This is primarily based on the fact that staff found no evidence of the shellfish harvesting beneficial use in the Soquel Lagoon. Hydraulic modifications, seasonal Lagoon closure to tidal circulation, lack of suitable physical conditions and lack of evidence of any historic (since 1975) or current shellfish harvesting have led Water Board staff to propose removing the shellfish harvesting beneficial use in the Soquel Lagoon. Appendix Four, "Use Attainability Analysis for the Soquel Lagoon," provides the basis for staff's proposal.

1.4. Water Quality Objectives

The Basin Plan states, "*Controllable* (emphasis added) water quality shall conform to the water quality objectives contained herein. When other conditions cause degradation of water quality beyond the levels or limits established as water quality objectives, controllable conditions shall not cause further degradation of water quality."

The Basin Plan contains specific water quality objectives that apply to fecal coliform (Basin Plan, pp. III-10 and III-12). These objectives are linked to specific beneficial uses and include:

1.4.1. Water Contact Recreation (REC-1)

Fecal coliform concentration, based on a minimum of not less that five samples for any 30-day period, shall not exceed a log mean of 200 per 100 ml, nor shall more than 10 percent of samples collected during any 30-day period exceed 400 per 100 ml.[2]

Escherichia coli (*E. coli*) is another pathogen indicator organism. The Basin Plan does not include water quality objectives for *E. coli*[3]. However, the United States

[2] Throughout this report, fecal coliform units are expressed as colony forming unit (CFU), organisms, count (#/100ml or CFU/100 ml) and most probable number (MPN). All unit expressions are considered equivalent fecal coliform bacteria concentration measures (Reference: Protocol for Developing Pathogen TMDLs).

Environmental Protection Agency (USEPA) recommends *E. coli* not exceed a log mean of 126 CFU per 100 ml, based on not less that 5 samples equally spaced over a 30-day period. The USEPA also recommends that not more than 10% of samples collected during a 30-day period exceed 235 per 100 ml. (USEPA, *Ambient Water Quality Criteria for Bacteria-1986*, January 1986*)*.

1.4.2. Non-Contact Water Recreation (REC-2)

Fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 2000 per 100 ml, nor shall more than 10 percent of samples collected during any 30-day period exceed 4000 per 100 ml.

1.4.3 Shellfish Harvesting (SHELL)

At all areas where shellfish may be harvested for human consumption, the median total coliform concentration throughout the water column for any 30-day period shall not exceed 70 per 100 ml, nor shall more than 10 percent of the samples collected during any 30-day period exceed 230 per 100 ml for a five tube decimal dilution test or 330 per 100 ml when a three-tube decimal dilution test its used. The Water Board is proposing to remove the shellfish harvesting beneficial use; therefore, these objectives will not apply.

1.4.4 Other Applicable Beneficial Uses

The Basin Plan does not include explicit numeric objectives for the other surface water beneficial uses.

1.5. Waste Discharge Prohibition

The Basin Plan contains the following discharge prohibition (Chapter Five, Section IV.B).

> "Waste discharges to the following inland waters are prohibited: All surface waters within the San Lorenzo River, Aptos-Soquel, and San Antonio Creek Subbasins and all water contact recreation areas except where benefits can be realized from direct discharge of reclaimed water."

[3] The State Water Resources Control Board plans to adopt *E. coli* water quality objectives in early 2007. According to Porter-Cologne, § 13170.The state board may adopt water quality control plans in accordance with the provisions of Sections 13240 to 13244, inclusive, insofar as they are applicable, for waters for which water quality standards are required by the Federal Water Pollution control Act and acts amendatory thereof or supplementary thereto. Such plans, when adopted, supersede any regional water quality control plans for the same waters to the extent of any conflict.

The Soquel Lagoon is within the Aptos-Soquel subbasin, and as such, no waste discharges are allowed to this waterbody.

2. WATERSHED DESCRIPTION

2.1. Location, Climate, and Hydrology

Soquel Creek flows from its headwaters in the Santa Cruz Mountains toward the city of Capitola and empties into the Pacific Ocean. The Soquel Lagoon (the Lagoon) is formed in Soquel Creek's southernmost reach within the City of Capitola. According to the U.S. Census Bureau, the City of Capitola population in the year 2004 was approximately 9,640.

The Lagoon is a receiving water for approximately 27,188 acres and drains into northern Monterey Bay. Land uses in the Soquel Watershed include bare, pasture, urban, and naturally vegetated which includes areas covered with forest, shrubs, and grasses. Two waterbodies, Noble Gulch (the Gulch) and Bates Creek, drain into the southernmost and most urbanized two miles of Soquel Creek. Noble Gulch is piped underground for the last 0.4 mile prior to draining into the Lagoon from the northeast. Bates Creek drains into Soquel Creek from the northeast approximately two miles north of the mouth of the Lagoon. Several other creeks flow into Soquel Creek in the upper Soquel Watershed (Figure 2-1).

Capitola Public Works Department constructs a sandbar across the mouth of the Lagoon each year in May and monitors breaching in the winter to avoid flooding.
The Lagoon's northernmost boundary is loosely defined as "somewhere between the Railroad Trestle and Nob Hill" (see Figure 2-2) based on observance of "the saltwater prism, which during high tide can extend as far upstream as Nob Hill" (personal communication, Steve Peters, Water Quality Specialist, Health Services Agency, County of Santa Cruz, March 9, 2006). Nob Hill is a market located adjacent to the Lagoon approximately 0.7 mile north of the mouth of the Lagoon.

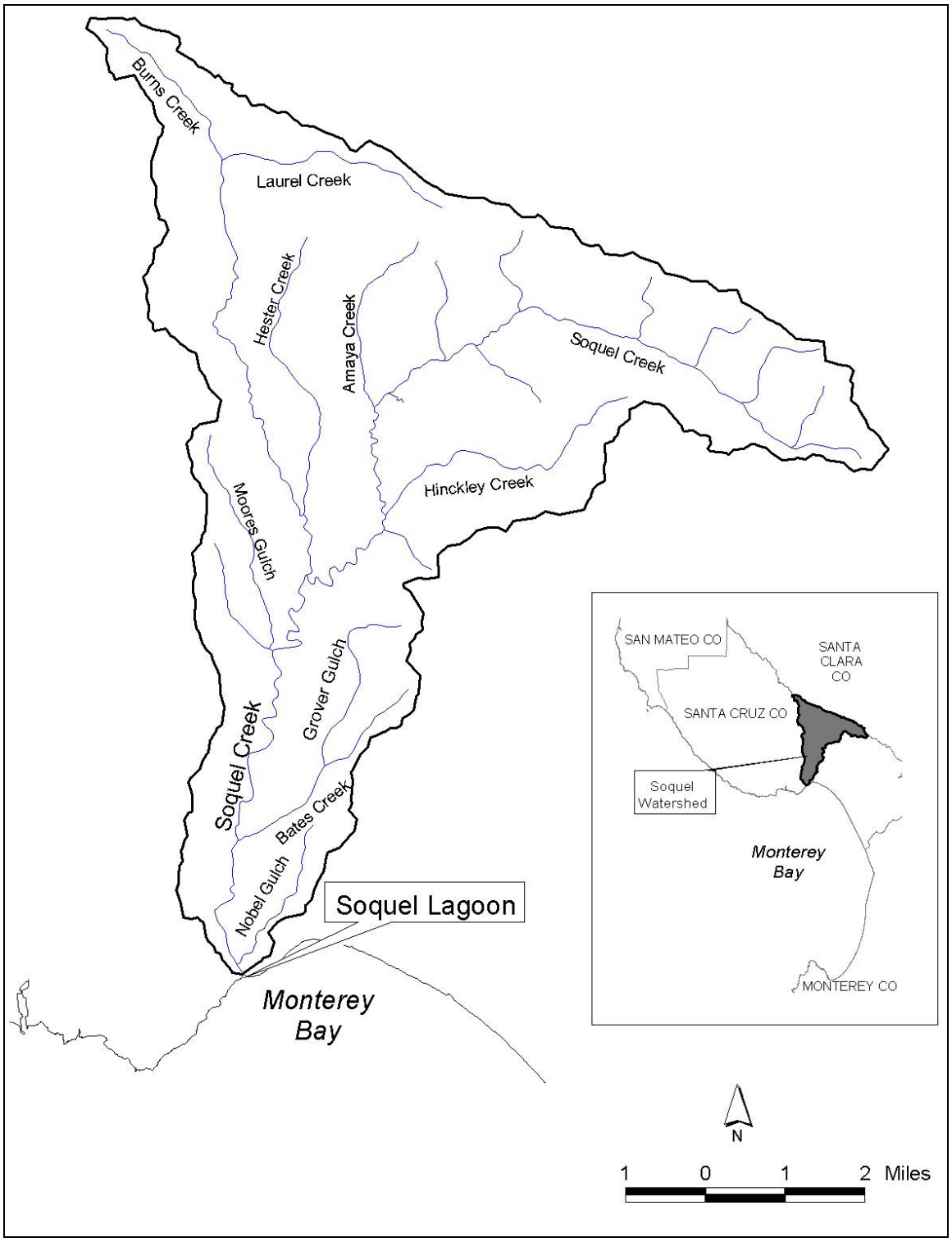


Figure 2-1. Waterbodies within the Soquel Watershed

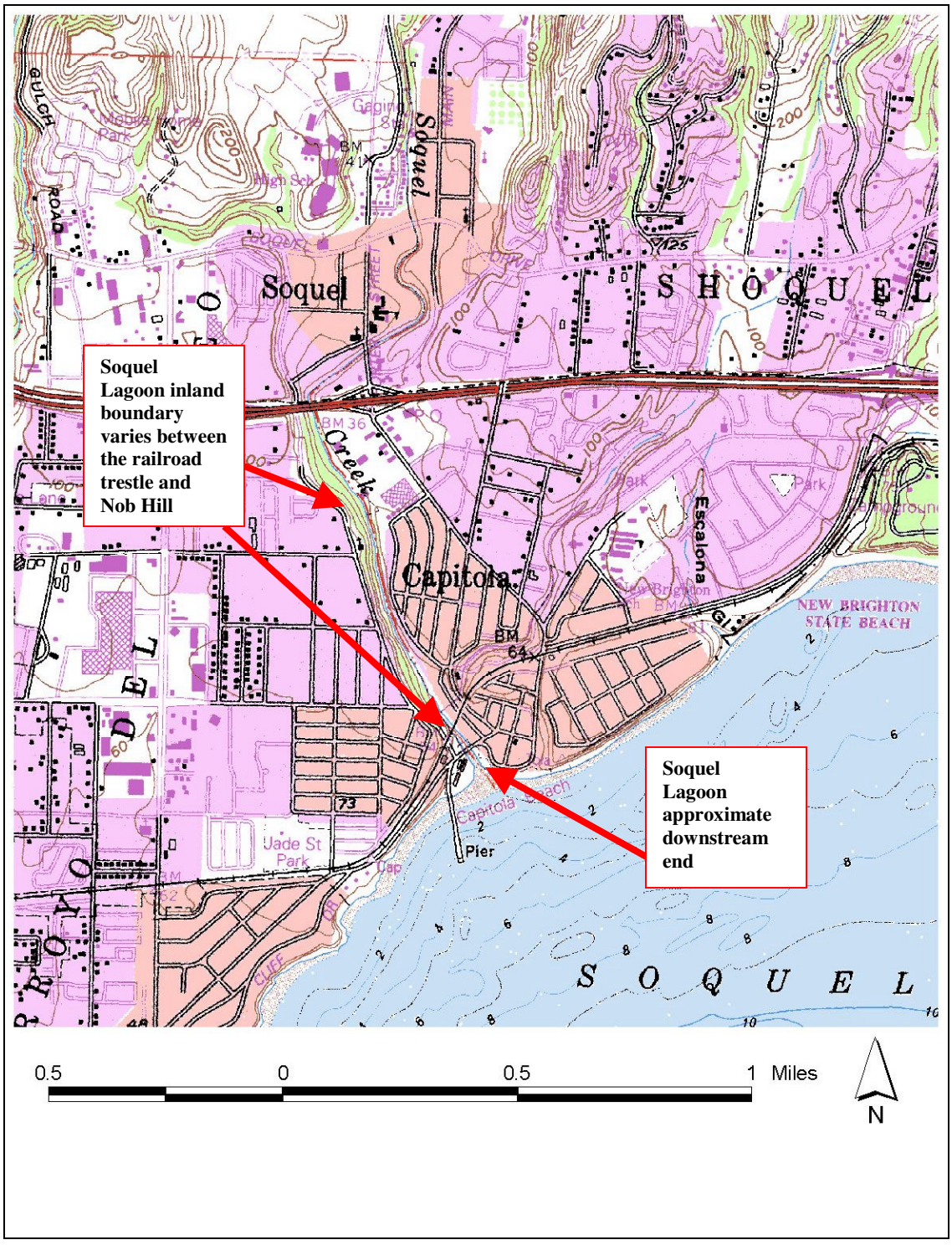


Figure 2-2. Soquel Lagoon Boundaries

The Soquel Watershed has a Mediterranean climate. Summers are warm and dry, cooled at times by fog at lower elevations due to the proximity of the Pacific Ocean. Winters are cool and wet. Average annual precipitation from October 1996 thorough April 2006 was approximately 21.80 inches at the City of Capitola (Figure 2-3). The wettest time of the year was generally from December to April.

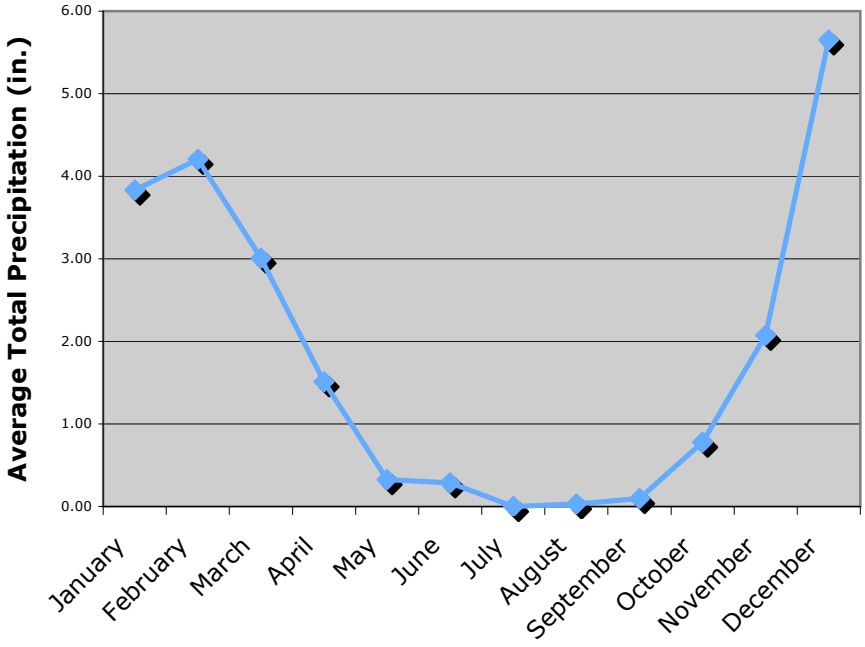


Figure 2-3. City of Capitola Average Monthly Precipitation from October 1996 through April 2006

Information provided in the *Assessment of Sources of Bacterial Contamination At Santa Cruz County Beaches* (Ricker and Peters, 2006) indicated that flow based on measurements at the mouth of Soquel Creek was 4.3 cubic feet per second (cfs). The document also indicated that flow in Soquel Creek, approximately 0.7 mile upstream from the mouth, was 4.0 cfs and in Noble Gulch was 0.2 cfs. Both flow rates were estimates. The flow rate estimate at approximately 0.7 mile upstream from the mouth was based on flow at the United States Geologic Survey gauge approximately 0.9 mile upstream of this location and was adjusted for input from the outfalls at this location. Outfall flow was based on the document, *Soquel Watershed Assessment and Enhancement Project Plan* (D.W. Alley, et al., 2003). The flow rate estimate in Noble Gulch was an educated guess. Although both of the later flow rates were estimates, they provide an idea of relative flow of the two waterbodies. All flow rates were representative of conditions in mid-summer.

2.2. Land Use

The Soquel Lagoon is affected by activities that occur within two governmental jurisdictions. These jurisdictions are the City of Capitola and the County of Santa Cruz. The California State Parks system also has jurisdiction over a portion of the upper Watershed (Figure 2-4).

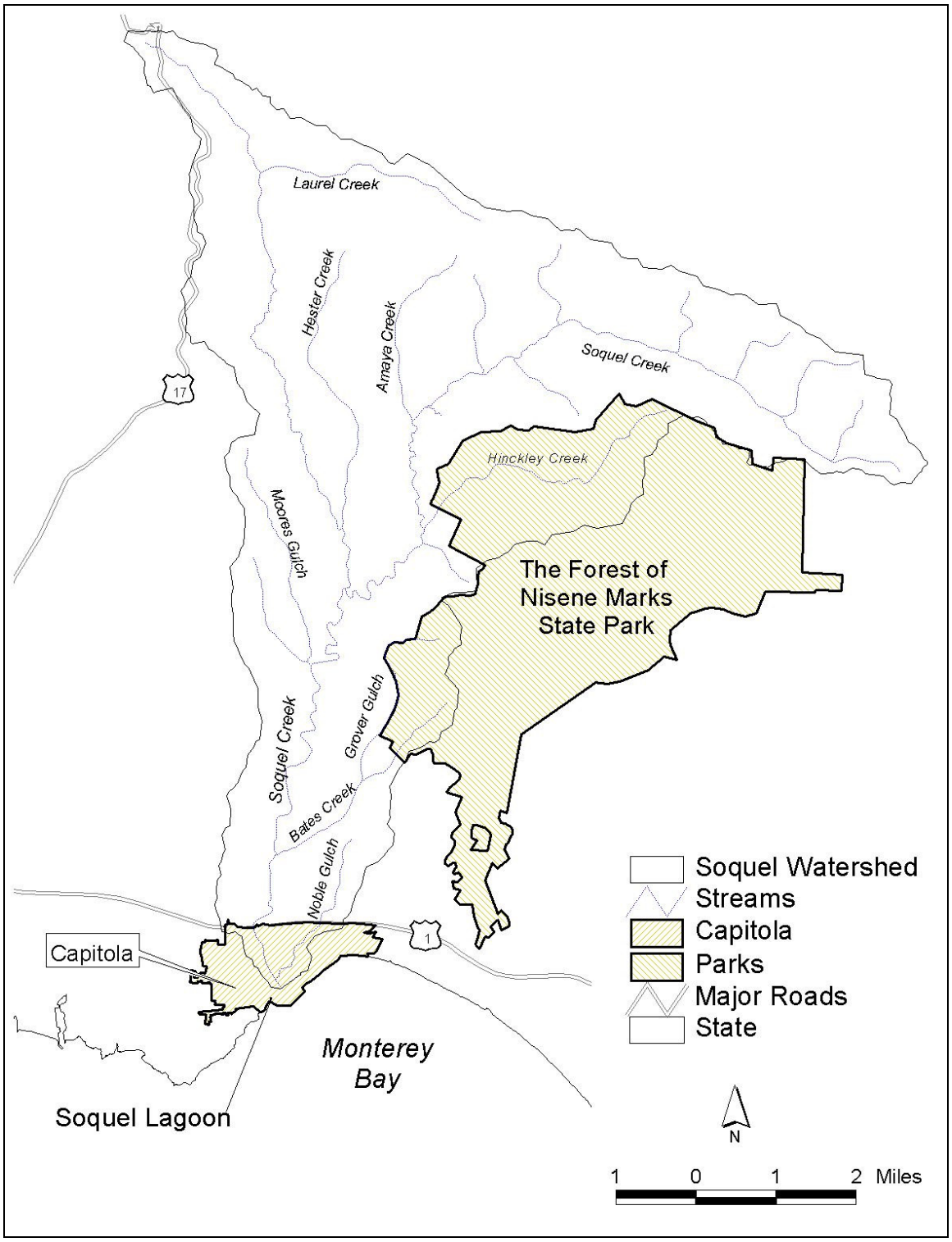


Figure 2-4. City of Capitola and the Forest of Nisene Marks State Park Boundaries

The Soquel Watershed is 42 square miles and is made up of the Soquel Subwatershed, Bates Creek Subwatershed and Noble Gulch Subwatershed (Figure 2-5). The largest of the three, the Soquel Subwatershed, drains approximately 38 square miles.

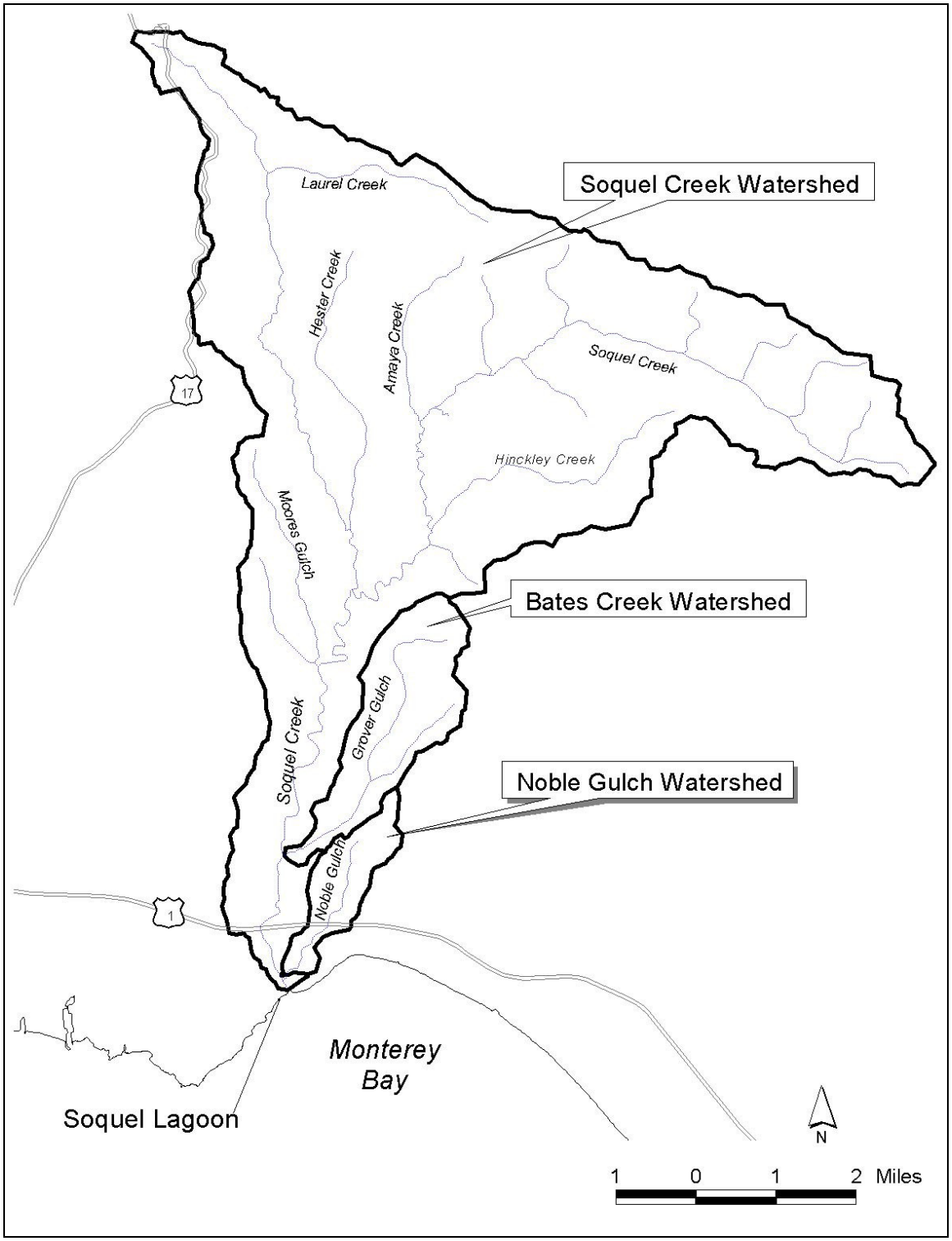


Figure 2-5. Subwatersheds of the Soquel Watershed

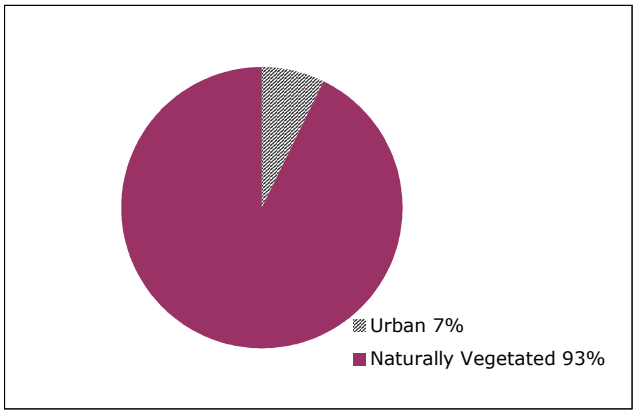


Figure 2-6. Percent land use for the Soquel Creek Subwatershed

Most of the land in the Soquel Creek Subwatershed (93 percent) was covered by naturally occurring vegetation (Figure 2-6). The second largest land use was urban at seven percent. The majority of urban land use was concentrated in the southern tip of the Subwatershed while forest and other naturally vegetated land uses covered the remainder of the Subwatershed. Although they were such small land uses that they do not show in Figure 2-6, pasture/hay, bare, and open water each covered less than one percent of the Subwatershed.

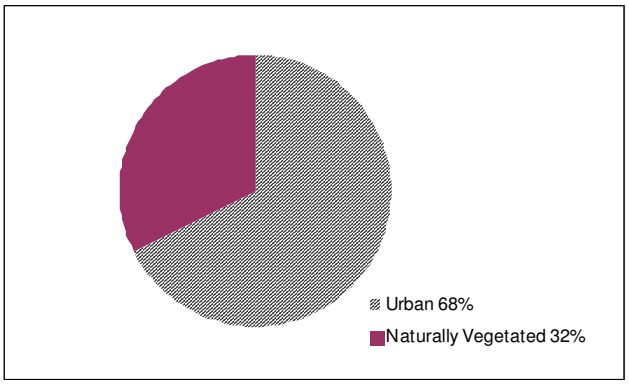


Figure 2-7. Percent land use for Noble Gulch Subwatershed

The extent of Noble Gulch was mostly surrounded by urban development, 68 percent of the land use cover in this Subwatershed (Figure 2-7). Naturally occurring vegetation covered 32 percent of this Subwatershed.

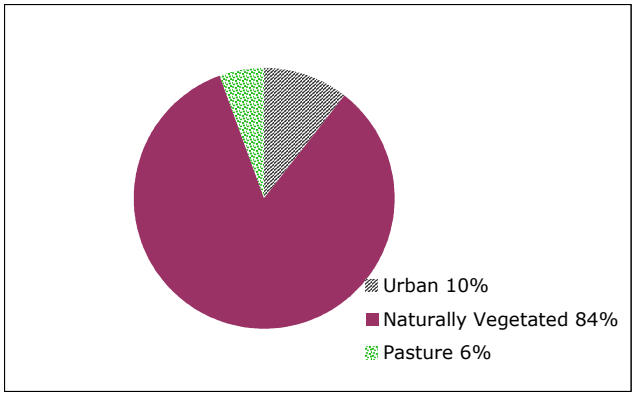


Figure 2-8. Percent Land Use for Bates Creek Subwatershed

The Bates Creek Subwatershed is farther upstream away from the more urbanized section of the Soquel Watershed than Noble Gulch. Therefore the majority of land (84 percent) was covered by naturally occurring vegetation (Figure 2-8). However 10 percent of the land use was urban, and six percent was pasture/hay.

Land uses that typically contribute pathogens are urban and pasture land. The majority of the Soquel Watershed urban use, including that of the Bates Creek and Noble Gulch Subwatersheds, was concentrated in the southern and downstream end of the Watershed within two miles of the Soquel Lagoon. Urban sources contributing to pathogens are discussed in Section 4.

3. DATA ANALYSIS

3.1. Water Quality Data

This section discusses the water quality data staff used to develop the TMDL, the results of water quality analyses, and the impacted areas. This report includes data from water quality sampling conducted by two sources: 1) The County of Santa Cruz Environmental Health Services, and 2) The Coastal Watershed Council (CWC). Data provided by the County was collected from 1986 to 2006; however, this report uses data collected from 2003 to 2006 between the Lagoon mouth and the West Branch of Soquel Creek at San Jose and Olive Springs Roads. Data provided by the CWC was collected in 2004 and 2005 from storm drains in the Capitola area. This report includes CWC data from those storm drains that empty into the Lagoon.

There were several stations sampled along Soquel Creek and Noble Gulch with very small data sets. Santa Cruz County staff tried to isolate "hot spots" of contamination and only sampled some of the locations a few times since 2003. The data was not included here due to the small sample sizes and because the *Water Quality Control Policy For Developing California's Clean Water Act Section 303(d) List* (State Water Resources Control Board, 2004) does not use data sets with sample sizes of less than five as a basis for considering listing. The data is included in Appendix 1.

Additional data provided by the County of Santa Cruz was submitted late in the writing of this report. Staff reviewed the data and concluded it would not change the implementation strategies of this report. However, staff included one of the data sets in this analysis because it replaced a former data set that was incorrectly labeled. The remainder of the data is included in Appendix 1.

3.1.1. Soquel Creek

Fecal coliform sampling activities for Soquel Creek are shown in the Table below.

Table 3-1. Santa Cruz County Environmental Health Services Fecal Coliform Sampling Locations and Period of Data Record in Soquel Creek

Station #	Station Location	Number of Samples from 2003 to 2006	Frequency of Samples from 2003 to 2006	Total Period of Record[1]
S0	Soquel Creek at Flume Outlet	211	2003 - Irregular 2004 to 2006 - Weekly	1987 to 2006
S04	Soquel Creek Above Stockton Bridge East	6	Irregular	1987 to 2005
S07	Soquel Creek at Railroad Trestle	58	Irregular	1986 to 2006
S23	Soquel Creek at Nob Hill	75	Irregular	1986 to 2006
S2315	Soquel Creek at Porter Street Bridge	35	Irregular	2003 to 2006
S6	West Branch Soquel Creek at San Jose at Olive Springs Road	42	Irregular	2003 to 2006

The County collected fecal coliform samples at the most downstream station in Soquel Creek (Soquel Creek at Flume Outlet) at least weekly from 2003 to 2006 with the exception of three months in 2003 (Figure 3-1). Approximately eight to 10 samples were collected each month in 2005 and January of 2006 at the same station. Four additional stations in the lowest 1.75 miles of Soquel Creek were sampled irregularly. Stations downstream of and including the Soquel Creek at Railroad Trestle sampling station provided information on fecal coliform levels in the Noble Gulch Subwatershed and storm drains emptying into Soquel Creek from the Soquel Creek at Nob Hill sampling station to the downstream end of the Lagoon. Stations from the Soquel Creek at Nob Hill sampling station to the Soquel Creek at Porter Street Bridge sampling station provided information regarding fecal coliform for a reach above the Lagoon but still within the urban section of the Soquel watershed and including some of Bates Creek watershed. The West Branch Soquel Creek at San Jose at Olive Springs Road sampling station (Figure 3-2) provides information regarding water quality from approximately half way upstream in the watershed, which is a receiving water for mostly rural residential and naturally vegetated land. Data collected from the Bates Creek at Soquel Creek sampling

[1] Data collection periods of record may contain gaps.

station, although it is a very small data set, provided information for the Bates Creek Subwatershed.

The figure below shows the Soquel Creek, Noble Gulch, and Bates Creek monitoring stations listed in Tables 3-1, 3-2, and 3-3. Below each station number are two additional numbers. The first number is the percent exceedance of 400 MPN and the second is the number of samples (since January 1, 2003). For example, Station S07 exceeded the 400 MPN objective 29 percent of the time based on 58 sample results.

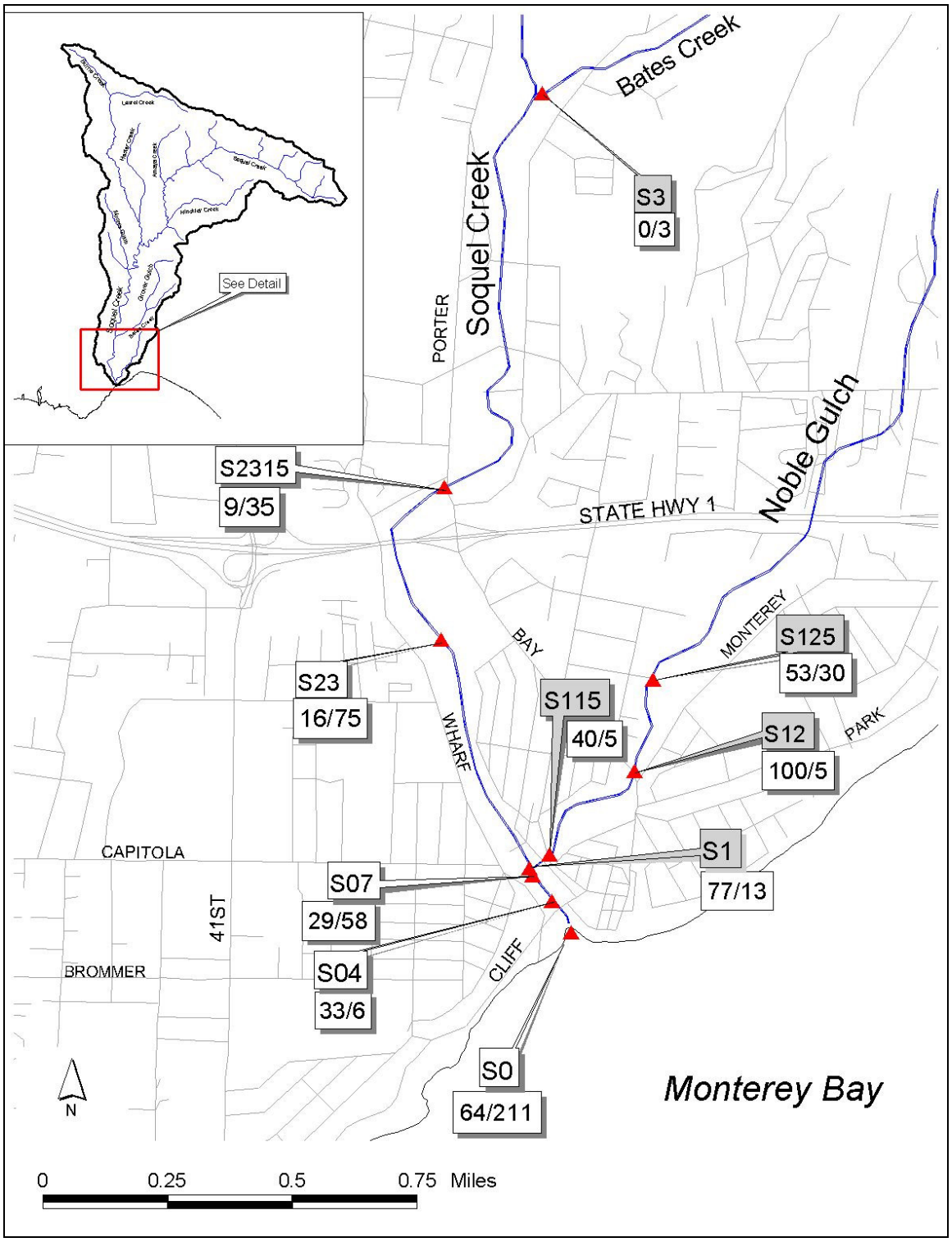


Figure 3-1. Soquel Creek, Noble Gulch, and Bates Creek Sampling Stations with Percent Exceedance over Number of Samples Since January 1, 2003. (Noble Gulch and Bates Creek Sampling Stations were Shaded to Separate them from the Remaining Stations.)

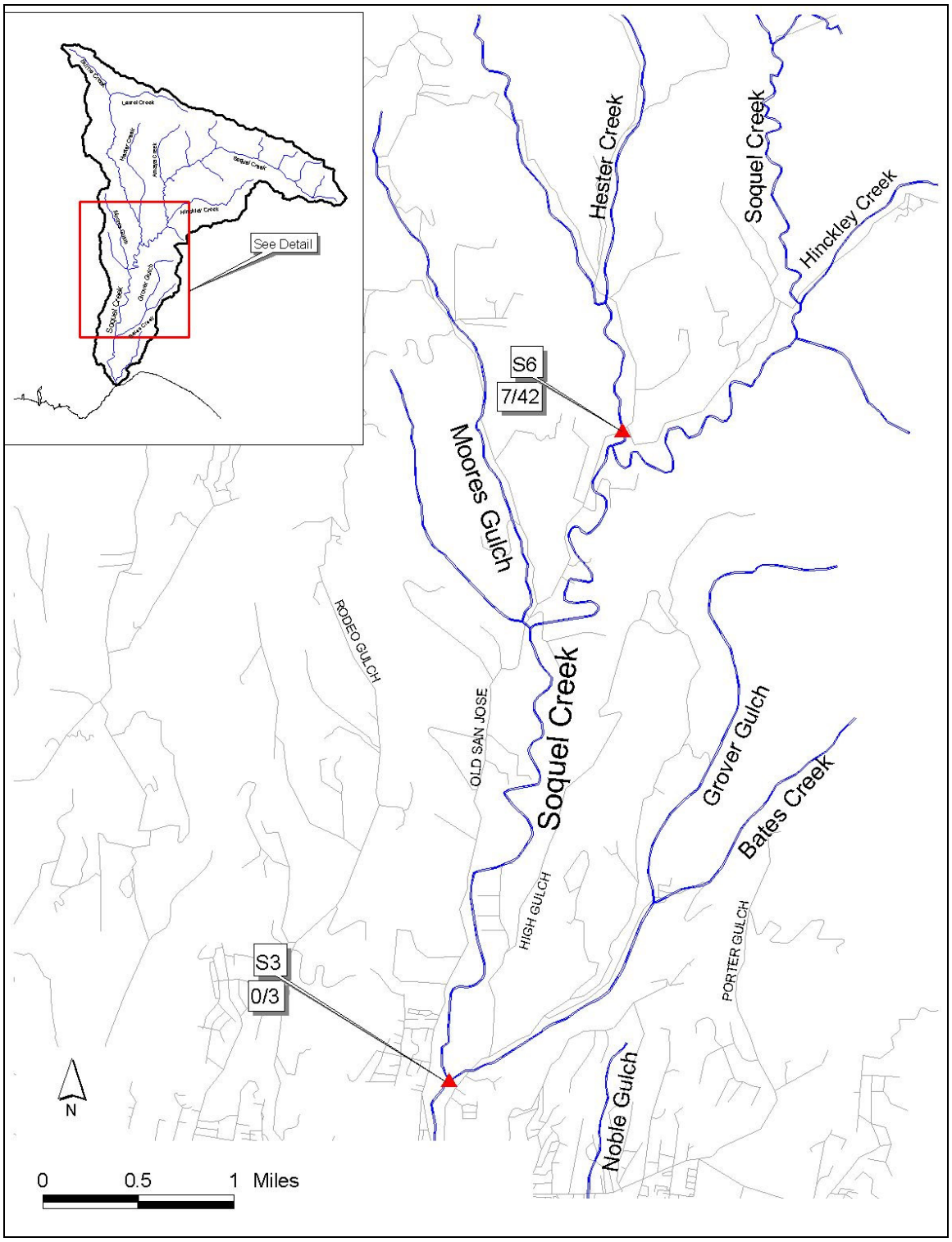


Figure 3-2. West Branch Soquel Creek at San Jose at Olive Springs Road Sampling Station (S6). (This Sampling Station was too far Upstream in the Watershed to include on Figure 3-1. The Bates Creek Sampling Station (S3) from Figure 3-1 was Included for Reference. Both Stations Show Percent Exceedance over Number of Samples since January 1, 2003.)

3.1.2. Noble Gulch

Recent fecal coliform sampling activities for Noble Gulch are shown in the Table below.

Table 3-2. Santa Cruz County Environmental Health Services Fecal Coliform Sampling Locations and Period of Data Record in Noble Gulch

Station #	Station Location	Number of Samples from 2003 to 2006	Frequency of Samples from 2003 to 2006	Total Period of Record[1]
S1	Noble Gulch at Soquel Creek	13	Irregular	1986 to 2005
S115	Noble Gulch at Pacific Cove Entrance	5	Irregular	2005
S12	Noble Gulch at Tunnel at Bay	5	Irregular	2003 to 2005
S125	Noble Gulch at St. Joe's Church	30	Irregular	2003 to 2006

Santa Cruz County Environmental Health Services sampled four stations on Noble Gulch irregularly. Sparse data from additional stations that were sampled on Noble Gulch were submitted, however were not included due to their small sample size. Furthermore, this data will not change the conclusions of this report. All data is included in Appendix 1 of this report.

Although Noble Gulch flowed at approximately 0.05 the rate of the flow of Soquel Creek (see Section 2.1), it discharged directly into the Lagoon. Therefore, analyzing data from Noble Gulch was important to the water quality analysis of this report.

[1] Data collection periods of record may contain gaps.

3.1.3. Bates Creek

Recent fecal coliform sampling activities for Bates Creek are shown in the Table below.

Table 3-3. Santa Cruz County Environmental Health Services Fecal Coliform Sampling Locations and Period of Data Record in Bates Creek

Station #	Station Location	Number of Samples from 2003 to 2006	Frequency of Samples from 2003 to 2006	Total Period of Record[1]
S3	Bates Creek at Soquel Creek	3	Irregular	2004 to 2005

The County collected fecal coliform samples at one Bates Creek station (Bates Creek at Soquel Creek) on three occasions in 2004 and 2005. This sampling site was just upstream of the confluence of Soquel Creek and Bates Creek. Although this is a small data set, it is included here to show that this is the only data from 2003 to 2006 and to support the conclusion in the monitoring section that more data is needed from this Creek.

3.1.4. Storm Drains

Santa Cruz County staff collected very few water samples from 2003 to 2006 in storm drains that drain to Soquel Creek because the sampling stations were either under the water level of Soquel Creek and could not be sampled, or they were dry. Therefore, Water Board staff did not draw any conclusions from this data.

The data provided by CWC used in this report was *E. coli* data collected at two storm drain sampling stations. Two total samples were collected in 2004 and eight total samples were collected in 2005 from storm drains that empty into Soquel Creek and Lagoon (the 2005 data is included in Appendix 1). The Creekside sampling station is located approximately 0.8 mile upstream of the mouth of the Lagoon and the Monterey Ave. station is located along Monterey Ave. approximately 0.3 mile northeast of the Lagoon.

3.1.5. Data Analysis Method

Staff analyzed Santa Cruz County Environmental Health water quality sampling results using a program titled "Fecal Coliform Investigation and Analysis Spreadsheet" (FECIA). FECIA is a fully automated spreadsheet designed to assist in characterization

and quantification of pathogen indicator instream water quality objectives exceedances. Observed data are compared against specified values equal to water quality objectives to determine the magnitude and nature of exceedances.

Staff used the FECIA program to generate the data analysis figures and tables located in Appendix Two of this report. Figures were generated for each sampling station. Each figure displays analyzed data collected from 2003 to 2006 as shown in the tables in Section 3.1. The figure displayed either the water contact recreation beneficial use geometric mean water quality objective or the water contact recreation beneficial use maximum water quality objective. The maximum water quality objective (400 MPN) was used when the County of Santa Cruz took less than five samples in a 30-day period. Concentration ranges, the range of concentrations within the 25^{th} -75^{th} percentile range, the mean concentration, and the median concentration are shown.

Staff also generated tables that summarized data on a monthly basis. Tables were generated for each sampling station. Each table shows the mean, median, minimum, maximum, the 25^{th} percent deviation, the 75^{th} percent deviation, the number of water quality objective exceedances, the sample count, and the percent sample exceedance.

There were only two 2004 CWC data samples, therefore formal analysis was unnecessary. CWC data from 2005 was analyzed by creating an Excel table of data and statistics. The table is located in Appendix One of this report.

3.2. Data Analysis Summary

This section summarizes data analysis results contained in Appendix One and Two. For each station sampled by Santa Cruz County, the percent violation of the geometric mean and maximum water quality objective are provided as well as the number of sample sets used to calculate the percent violation. FECIA calculated violations of the geometric mean water quality objective when five or more samples were available in a 30-day period. Sampling stations are listed from the most downstream station to the most upstream station on all three waterbody tables.

3.2.1. Soquel Creek

Table 3-4 shows the percent violation of the maximum water quality objective (for fecal coliform) and the number of samples used to determine the percent violation of the maximum water quality objective in Soquel Creek.

Table 3-4. Soquel Creek Percent Violations of Water Quality Objectives Since January 1, 2003

Station #	Station Location	Geometric Mean Water Quality Objective (200 MPN)		Maximum Water Quality Objective (400 MPN)	
		% Violations	Number of Samples Sets	% Violations	Number of Samples
S0	Soquel Creek at Flume Outlet	87	193	64	211
S04	Soquel Creek Above Stockton Bridge East	100	2	33	6
S07	Soquel Creek at Railroad Trestle	80	25	29	58
S23	Soquel Creek at Nob Hill	19	43	16	75
S2315	Soquel Creek at Porter Street Bridge	(1)	(1)	9	35
S6	West Branch Soquel Creek at San Jose at Olive Springs Road	(1)	(1)	7	42

(1) Insufficient data to calculate geometric mean

3.2.2. Noble Gulch

Table 3-5 also shows the percent violation of the maximum water quality objective and the number of samples used to determine the percent violation of the maximum water quality objectives in Noble Gulch.

Table 3-5. Noble Gulch Percent Violations of Water Quality Objectives

Station #	Station Location	Geometric Mean Water Quality Objective (200 MPN)		Maximum Water Quality Objective (400 MPN)	
		% Violations	Number of Samples Sets	% Violations	Number of Samples
S1	Noble Gulch at Soquel Creek	100	2	77	13
S115	Noble Gulch at Pacific Cove Entrance	(1)	(1)	40	5
S12	Noble Gulch at Tunnel at Bay	(1)	(1)	100	5
S125	Noble Gulch at St. Joe's Church	100	5	53	30

3.2.3. Bates Creek

Table 3-6 also shows the percent violation of the maximum water quality objective and the number of samples used to determine the percent violation applicable of the maximum water quality objectives in Bates Creek.

Table 3-6. Bates Creek Percent Violations of Water Quality Objectives

Station #	Station Location	Geometric Mean Water Quality Objective (200 MPN)		Maximum Water Quality Objective (400 MPN)	
		% Violations	Number of Samples Sets	% Violations	Number of Samples
S3	Bates Creek at Soquel Creek	(1)	(1)	0	3

3.3. Clarifying Spatial Representation of Waterbodies Needing TMDL

This section characterizes the status of Soquel Creek, Noble Gulch, Bates Creek, and storm drains sampled by CWC in terms of fecal coliform and *E. coli* levels. The Subwatersheds and the waterbodies are identified using Figures 2-5 and 3-1.

3.3.1. Soquel Creek

Fecal coliform objectives were exceeded from the mouth of the Lagoon upstream to the Soquel Creek at Porter Street Bridge sampling station. However, the percentage of exceedances at each sampling station decreased moving upstream from 64 percent at the mouth of the Lagoon to nine percent at the Soquel Creek at Porter Street Bridge station. This trend extended into the next approximately 0.5 mile reach upstream of this station. Only one of 16 samples exceeded water quality objectives in this reach. However, this was based on a combination of very small sample sets collected at various stations within the reach (from 2003 to 2005). Although a robust data set was lacking at any one station within that reach, considered together the data supported the conclusion that impairment decreased upstream from the Lagoon. These data sets were not listed in this section but are included in Appendix 1. The farthest upstream station (West Branch Soquel Creek at San Jose at Olive Springs Road, approximately 4.5 miles upstream of the Lagoon) at which data was collected exceeded the water quality objective in only seven percent of the samples indicating no impairment.

3.3.2. Noble Gulch

Fecal coliform objectives were exceeded in Noble Gulch at three of the four sampling stations downstream of and including the Noble Gulch at St. Joe's Church sampling

station, approximately 0.6 mile upstream of the confluence of Noble Gulch and Soquel Creek.

Although the unanalyzed data sets (described above in Section 3.1) for this waterbody were small, the data, when considered together, supported the conclusion that Noble Gulch was impaired. All of the data (nine samples collected in February and March of 2005 within an approximately 0.75 mile reach upstream from Highway One) at four stations exceeded the water quality objective.

3.3.3. Bates Creek

Only one station was sampled in Bates Creek located just prior to the confluence of Bates and Soquel Creeks. No fecal coliform maximum objective (400 MPN per 100 ml) exceedances were recorded at this station for the 3 samples collected from 2004 to 2005. Staff did not make a conclusion regarding the potential impairment of this waterbody, as the integrity of such a small data set was limited.

3.3.4. Storm Drains

E. coli water quality objectives were exceeded at the Creekside and Monterey Ave (CWC) sampling stations in 2005. However, exceedances at the Creekside station only occurred one time out of four. Exceedances at the Monterey Ave. station occurred four times out of four. Both storm drains empty into Soquel Creek, although, the Monterey Ave station is within the Noble Gulch and Soquel Creek Subwatersheds. Although the sample sizes were small, water board staff concluded this data may suggest stormwater discharges carry pathogens to Soquel Creek but this should be considered in conjunction with other evidence (such as urban runoff pathogen contributions in other watersheds, ribotyping data, and land uses). Additionally, staff concluded that more samples should be collected from storm drains in this area. Noble Gulch was impaired and whatever is contributing to the Monterey Ave station could also contribute to impairment of Noble Gulch, as the two drainages are close to each other. The Monitoring Plan in Section 11 of this report establishes requirements for the County of Santa Cruz to sample storm drains.
Staff developed the TMDLs in this report for the impaired reaches of the waterbodies described above and the corresponding subwatersheds.

3.4. Water Quality Investigation Results

3.4.1 Microbial Source Analysis

Genetic ribotyping is one method of microbiological source analysis and was utilized to identify microbiological sources in Soquel Lagoon and Noble Gulch. The genetic ribotyping method differentiated sources of *E. coli*. The University of Washington Public

Health Department worked with over 100,000 *E. coli* samples and developed a genetic fingerprint that is specific to *E. coli* sources. This method compares RNA band patterns extracted from *E. coli* in contaminated stream sites and known sources of *E. coli*. Numerous entities in California successfully used this method, including California Polytechnic State University's (San Luis Obispo) study of Morro Bay, California. Although this report presents various sources in "percent contribution" values, staff considered the ribotyping results only as an estimate of possible sources and of relative source contributions among all of the various sources.

Santa Cruz County personnel collected fecal coliform samples for ribotyping analysis from three of the sampling stations on Soquel Creek (S0, S04, and S23), one of the sampling stations on Noble Gulch (S1), and an additional station on Noble Gulch (S11D) that was originally thought to be a storm drain (Noble Gulch is piped underground for its last approximately 0.4 mile prior to entering Soquel Creek). The sampling stations are shown in Figure 4–1.

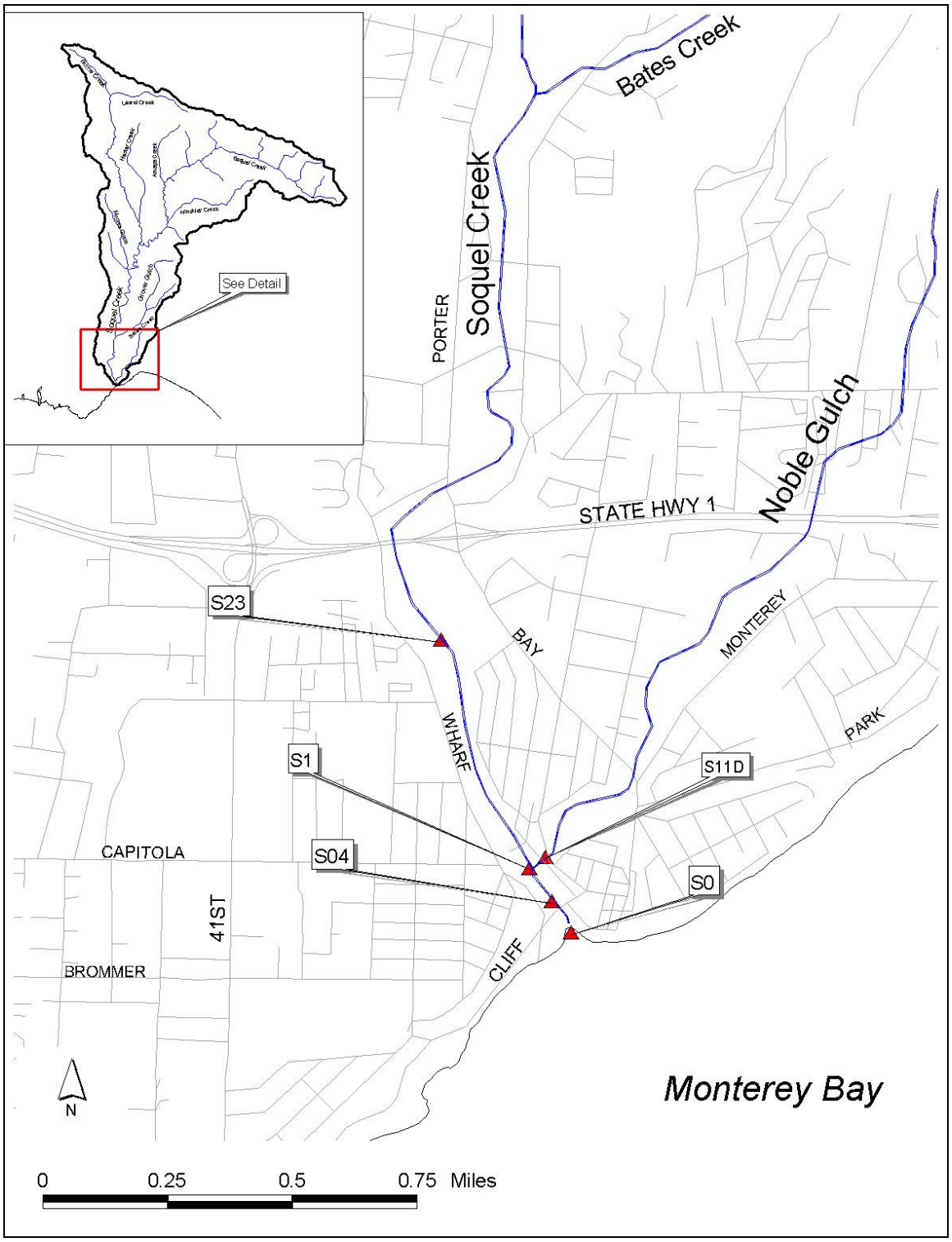


Figure 3-2. Soquel Creek and Noble Gulch Ribotyping Data Collection Stations

Ribotyping samples were collected between January 13, 2004 and March 17, 2005. Percent source contributions from samples collected during both wet and dry seasons combined are presented in Table 4-1. Table 4-2 contains the percent source contributions separated into wet and dry seasons.

Table 3-7..Percent Source Contributions from Ribotyping Data

Sites	Soquel Creek at Flume Outlet (SO)	Soquel Creek Above Stockton Bridge East (S04)	Soquel Creek at Nob Hill (S23)	Noble Gulch at Soquel Creek (S1)	Noble Gulch at Blue Gum and Riverview (S11D)
Dates	**1/13/04 to 9/21/04**	**6/6/05 to 2/17/05**	**1/21/04 to 2/17/05**	**1/13/03 to 2/17/05**	**7/11/05 to 9/28/05**
Source	**Percent Source Contribution**				
Bird	54	46	48	64	36
Wildlife	7	31	10	16	21
Rodent	13	7	14	10	14
Dog	13	10	9	2	21
Human	6	0	6	4	4
Unknown	5	1	9	4	0
Cat	1	4	3	0	0
Horse	0	0	1	0	1
Cow	0	0	0	0	0
Marine Mammal	0	0	0	0	0
Total Water Samples	36	21	51	16	9
Total Isolate Samples	112	68	151	50	28

Based on this combined wet and dry season study birds were the largest contributing source of fecal coliform at 36 percent or more from all five sampling stations. Other sources, wildlife (raccoon, deer, and opossum), dog, and rodent were present at all five stations and contributed a significant percentage of the fecal coliform. We also observed a four to six percent human contribution to fecal coliform at all but one of the sampling stations, Soquel Creek Above Stockton Bridge East. However, this station was downstream of another station that did have a human source. Horse was identified as contributing one percent of the fecal coliform isolates in both Soquel Creek and Noble Gulch. Dog, human, horse, and cat sources were considered controllable sources because they are present as a result of human activities and land management. Bird, wildlife, and rodent sources are generally considered natural and uncontrollable because their presence is generally not a result of human activities. However, bird, wildlife, and rodent sources are controllable to some degree. For example, these animals are attracted to trash dumpsters and areas where human activities involving food occur. Therefore, they are present partially as a result of human activities. Some of their waste can be controlled by managing those human activities.

Table 3-8. Variation of Fecal Coliform Sources During Wet and Dry Seasons (January 2003 - September 2005)

Sites	Soquel Creek at Flume Outlet (SO)		Soquel Creek Above Stockton Bridge East (S04)		Soquel Creek at Nob Hill (S23)		Noble Gulch at Soquel Creek (S1)		Noble Gulch at Blue Gum and Riverview (S11D)	
Dates	**1/13/04 to 9/21/04**		**6/6/05 to 2/17/05**		**1/21/04 to 2/17/05**		**1/13/03 to 2/17/05**		**7/11/05 to 9/28/05**	
	Wet[1]	**Dry[2]**	**Wet[1]**	**Dry[2]**	**Wet[1]**	**Dry[2]**	**Wet[1]**	**Dry[2]**	**Wet[1]**	**Dry[2]**
Total Water Samples	36		21		51		16		9	
Total Isolate Samples	10	102	10	58	22	129	19	31	0	28
Total Days of Wet Season Sampling	1		1		2		2		0	
Source	**Percent Source Contribution**									
Bird	40	55	40	47	32	51	63	65	(1)	36
Wildlife	10	7	10	34	23	8	32	6	(1)	21
Marine Mammal	0	0	0	0	0	0	0	0	(1)	0
Dog	30	12	10	10	5	9	5	0	(1)	21
Human	10	6	0	0	5	6	0	6	(1)	4
Horse	0	0	0	0	5	0	0	0	(1)	4
Cow	0	0	0	0	0	0	0	0	(1)	0
Cat	0	1	20	2	0	4	0	0	(1)	0
Unknown	10	5	0	2	14	9	0	6	(1)	4
Rodent	0	15	20	5	18	13	0	16	(1)	14

[1] Wet = Samples collected during a time when rain occurred within the previous 72 hours
[2] Dry = Samples collected during a time when more than 72 hours occurred without rain
(1) No samples collected during the wet season at this station.

There was not enough wet season data to draw conclusions about wet versus dry season sources (Table 4-2). In order to accurately characterize the relative contribution from different sources of fecal contamination at a particular location, it is important to analyze 50-100 bacterial isolates (individual colonies) collected from that location over time (*Assessment of Sources of Bacterial Contamination At Santa Cruz County Beaches*, Rickers and Peters, 2006). None of the above data sets collected on wet days were based on sufficient isolate numbers. However, data derived from wet season sampling can still be used in terms of identifying at least some of the contributing sources. This is why wet and dry season data was analyzed in Table 4.1 after being combined.

No contribution from cows was recorded in this study. However, had there been greater numbers of samples collected in the wet season, particularly after the first rain event, cow or other agricultural animal sources in addition to a higher contribution from horses may have been detected. Farm animal contribution is discussed further in Section 4.2.6.

A second reason for performing wet season sampling is to determine if the human component increases during wet weather. This would suggest that septic systems are dysfunctional and/or that the sewer collection system is leaking and waste is transported to storm drain systems during storm events. Additional information included in Sections 4.2.1 and 4.2.5 was used to determine whether or not septic or sewer systems were a significant source of pathogens to the Soquel Lagoon.

4. SOURCE ANALYSIS

This source analysis was based on existing water quality data, wastewater spill data, microbial source data, land use, flow estimates, discussions with staff at County of Santa Cruz Health Services Agency, City of Capitola Public Works, Santa Cruz County Sanitation District (SCCSD), Coastal Watershed Council, and observations made in the field. This analysis also considered information provided in a report prepared by the County of Santa Cruz, Environmental Health Services, Water Resources Program titled *Assessment of Sources of Bacterial Contamination at Santa Cruz County Beaches* prepared in March, 2006.

4.1. Mechanisms of Transport for Various Sources of Bacteria

This section discusses pathogen sources of concern in the Soquel Watershed that are subject to regulation by the Water Board. The modes by which various sources provided in Tables 4-1 and 4-2 reach the Soquel Lagoon are discussed.

Local agencies and landowners already implemented many corrective actions that resulted in improved water quality. This report provides some additional measures local agencies and landowners can use to continue the water quality improvement efforts already begun.

4.1.1. Sewage Spills and Leaks from Sanitary Sewer System

Sewage can reach the Lagoon from sewer line overflows (spills) or leaks. Sewage spills can occur when roots, grease buildup, or other debris block sewer lines. Some spills from the SCCSD's collection system reached the Soquel Lagoon in 2002, 2003, and 2004. Leaks can occur from cracked lines or lines with faulty connections. When sewer lines are blocked or leaking, sewage may run onto the street, into gutters, and into storm drains. Sewer leaks can also occur in small volumes and below the ground. These types of leaks often continue unnoticed. SCCSD provided evidence that several sewer main lines were leaking prior to and including last year. Sewage spills and leaks contain human waste. Ribotyping analysis indicated that at two Lagoon sampling stations humans generated six percent of the sampled fecal coliform. Humans were also identified as generating four percent of the fecal coliform in two stations on Noble Gulch. Staff concluded that sewage was a likely source of pathogens in the Lagoon; however, staff also concluded that current management practices and permit requirements are adequate to control these sources.

The Soquel Watershed does not have a Waste Water Treatment Plant (WWTP) within its boundaries. However, the Watershed has a collection system that collects wastewater from the City of Capitola and a portion of Santa Cruz County within the Watershed's boundaries and takes this wastewater to the City of Santa Cruz's WWTP. The SCCSD's

Waste Discharge Requirements (WDR), Order No. R3-2005-43, addresses the County's collection system. Areas of the Soquel Watershed not connected to the SCCSD collection system are on septic systems.

The SCCSD main line crosses underneath Soquel Creek and the Lagoon. The main crosses Soquel Creek at Porter Street between Soquel Wharf Road and Main Street, and the Soquel Lagoon near the Nob Hill at Soquel Creek sampling station where the main crosses toward Soquel Wharf Road. It crosses in a third location at the Stockton Avenue Bridge. Locations are labeled A, B, and C, respectively, on Figure 4-1. The main also parallels Noble Gulch throughout most of its reach (within approximately 25 to 400 feet). The main is inspected once every year during routine cleaning (personal communication, Diane Romeo, Sanitation Engineering, SCCSD, May 5, 2006).

The SCCSD Engineering and Operations Staff supplied a report, *Capitola Video Results* (March, 2006), summarizing an inspection of sections of the sewer main in the City of Capitola. The report indicated that the sewers adjacent to Soquel Creek and in the upper village area were constructed primarily in the 1960s of rigid clay or asbestos concrete. It also summarized the results of the investigation of approximately 4,460 feet of sewer main that was televised in February 2006 after winter storm events produced 0.71 inches of rain. There were only a few spots where water was observed trickling into the pipe due to saturated soils. However, due to cracking, offset joints, chipping, and non-water tight lateral connections showing a slime build up (indicative of water leaking into the system), it was evident that the sewer main was most likely leaking inwardly and outwardly. The report also indicated that several lateral connections at the main were leaking (lateral connections are discussed in Section 4.2.2.f.). During the wet season, these conditions contribute to sewer system overflow (or spills) by rainfall and groundwater infiltration. Conversely, sewage exfiltration potential exists in dry seasons (exfiltration occurs when sewage leaks underground).

The report indicated that the sewer main in the worst condition was along Cherry and San Jose Avenues located in the Esplanade section of Capitola, which is east of and adjacent to the Lagoon. Several sections were cracked and lateral connections extended into the sewer main with slime build up below. Many as-built plans were missing and the mapping of the sewer lines was incomplete. Some of the manholes in the Capitola village area showed inlet piping that may or may not be abandoned. Occasionally, sewer mains that were considered abandoned were determined functional and connected to residences. Furthermore, some of the manholes were constructed of brick. Water in the rainy season can leak around the bricks and into the sewer system causing overflows (or spills).

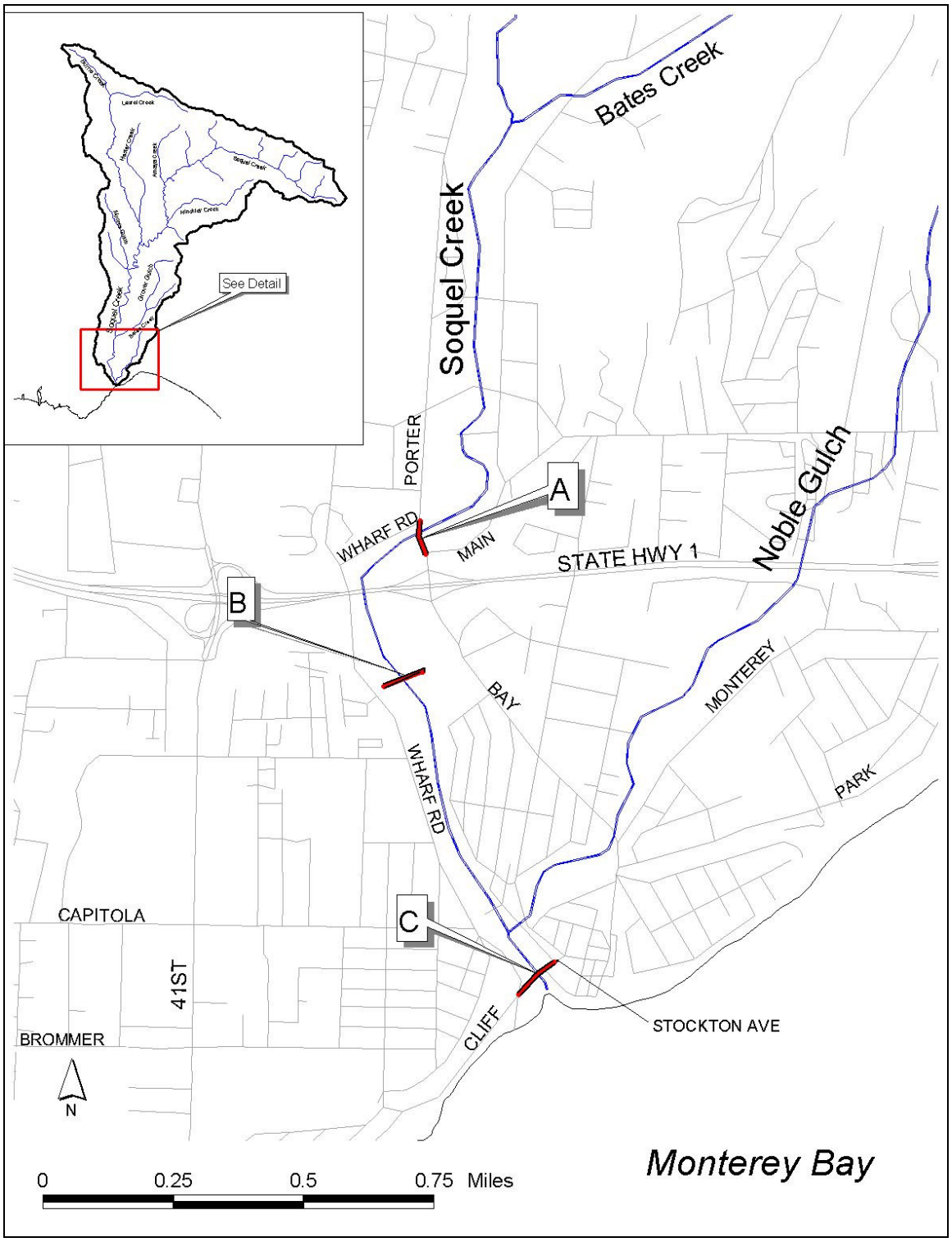
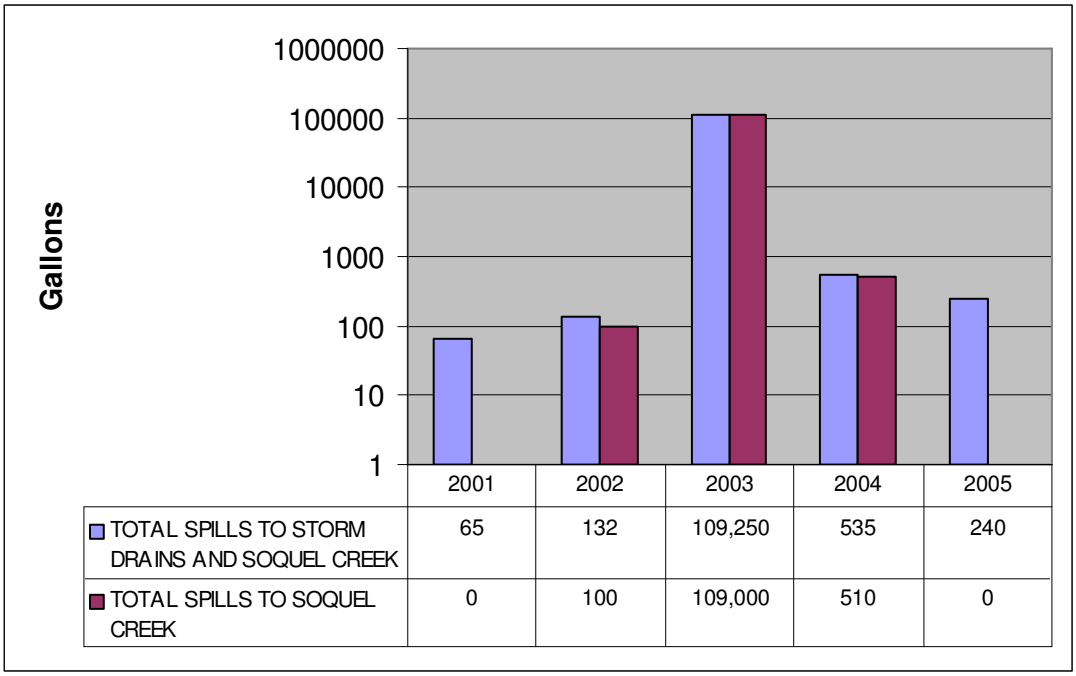


Figure 4-1. Locations where the sewer main crosses under Soquel Creek (A: Porter Street between Soquel Wharf Road and Main Street, B: Near Nob Hill at Soquel Creek sampling station toward Soquel Wharf Road, and C.: Stockton Avenue Bridge)

Additionally, sections of main along Riverview Avenue (located approximately 125 to 200 feet from the Lagoon) were found in poor condition in past inspections. Furthermore, a videotape prepared last year showed that the Soquel Wharf Road sewer main was in poor condition with areas where a portion of the pipe was missing. Of the 13 manholes on this sewer, at least nine were constructed of brick (*Capitola Video Results*, SCCSD Operations and Engineering, 2006).

Several hundred feet of sewer main located east of Soquel Creek were replaced with PVC pipe since the 1980s. Communication with Rachel Lather of the SCCSD in July of 2006 indicated that a section of the sewer main was replaced recently along Riverview Avenue in the Esplanade area between Oak Drive and Gilroy Drive. Other sections along Riverview Avenue were replaced previous to that section. Lather also described sections of main scheduled for replacement in 2006 and 2007 that include an additional section along Riverview Avenue, and several sections within the Esplanade. Repairs will also include taking the sewer main off the cliff face along Grand Avenue where it was exposed. The section of main on Soquel Wharf Road will not be replaced in the coming year due to the topography and geology of the area in which it is located. Other sections of main were thought to be in worse condition and to have a greater impact on water quality. Lather also told water board staff that there was close communication with John Ricker, Water Resources Program Coordinator, Health Services Agency, County of Santa Cruz, when prioritizing the Capital Improvement Projects of the SCCSD for the following year. Furthermore, the SCCSD submitted a Collection System Management Plan per the requirements of the WDR in February of 2006. The plan summarized how sections of main are inspected and by whom, assumptions about the system used to project long term Capital Improvement Projects, and the basis for priority of replacement. Collection system replacement is based on investigations of the general condition of the system.

The sewers problems were not just leaks, but blocks and spills in addition. Sewer main blockage that did not require clean up action in addition to blockage that resulted in spills was partially due to the faultiness of the collection system as described above, but also due to obstructions such as grease, wood, rags, and hair. Spill data was compiled into the following graph and table in Figure 4-2.



	2001	2002	2003	2004	2005
TOTAL SPILLS TO STORM DRAINS AND SOQUEL CREEK	65	132	109,250	535	240
TOTAL SPILLS TO SOQUEL CREEK	0	100	109,000	510	0

Figure 4-2. Total sewage spills to storm drains and Soquel Creek from 2001 to 2005

From 2001 through 2005, 23 spills were reported that were a result of SCCSD collection system failure within the Soquel Watershed. The largest spill volume occurred in 2003 amounting to 109,205 gallons (one spill reported in 2003 that did not reach a waterbody was reported as < 200 gallons and was included in the graph as 199 gallons). Of this total 109,000 gallons eventually reached Soquel Creek. Two spills that occurred that year were relatively large with one measuring 100,000 gallons and the other measuring 9,000 gallons. The 9,000-gallon spill also entered Noble Gulch. The total volume of spills in each of the other four years was 535 gallons or less. Spills did not reach the Soquel Lagoon in 2001 and 2005.

The SCCSD implemented an overflow emergency response plan to minimize the effects of spills upon surface waters. When spills occurred, the SCCSD determined if the spills entered storm drains. If the spill entered the storm drain, they determined where the spill migrated and "trapped" the spill. The SCCSD extracted the spills from the storm drains and hauled the sewage to the wastewater treatment plant. Spills that did not reach water bodies were vacuumed, absorbed, raked-up, or diluted with fresh water.

Based upon the information above, Water Board staff concluded collection system leaks were a chronic problem. However, staff concluded that collection system problems are being sufficiently addressed through the current practices of the SCCSD and the annual reports they must submit in compliance with their WDR.

4.2.2. Storm Drain Discharges

Storm drain discharges have the potential to contain human waste from municipal system sewage spills and leaks (discussed in Section 4.2.1) and urban runoff, including pet waste and dumpster leachate, which are controllable sources, and bird and rodent waste, which are sources that are controllable to some degree (as explained in Section 4.1). Based on the ribotyping analysis (Section 4.1) and land use that is mainly urban surrounding the Lagoon, staff concluded that these sources were likely present in the storm drain discharge within the Soquel Watershed. These sources and their transport mechanisms are discussed below.

Water samples collected via the CWC within storm drains were few. Although the sample sizes were small, water board staff concluded this data may suggest stormwater discharges carry pathogens to Soquel Creek but this should be considered in conjunction with other evidence (such as urban runoff pathogen contributions in other watersheds, ribotyping data, and land uses). Additionally, staff concluded that more samples should be collected from storm drains in this area. Noble Gulch was impaired throughout the range of sampling stations. Whatever is contributing to the Monterey Ave (storm drain) station could also contribute to impairment of Noble Gulch as it is very close. One reason for small sample sizes in this watershed by CWC was that storm drains chosen for sampling were dry during the sampling periods. The Monitoring Plan in Section 11 of this report establishes requirements for the County of Santa Cruz to sample storm drains.

The City of Capitola received funds from the Clean Beaches Initiative Grant Program to reduce bacterial inputs at Capitola Beach and Soquel Creek. The *Village Drainage Improvement Plan* (City of Capitola, 2004) described the top priority projects to be implemented with the funds. The number one priority of the Plan was a dry weather diversion system that was recently completed. The diversion system is expected to improve water quality and reduce pathogen loading from the sources described above in the Lagoon during the time of operation, May through October. Runoff from the Esplanade and restaurants between the Esplanade and Soquel Creek was identified as a key source of bacterial pollution. A portion of this runoff directly entered the Lagoon through the Fog Bank outfall. The diversion, which included the construction of a small subsurface pump station, will redirect this runoff to the sanitary sewer system and eventually to the wastewater treatment facility in the City of Santa Cruz.

4.2.2.a. Controllable Bird Waste

Fecal coliform ribotyping results indicate birds were the largest source of fecal coliform in the Lagoon (46 percent or greater at all three Soquel Creek sampling stations) and in Noble Gulch. Birds frequent locations such as dumpsters and trash cans as feeding sites. Birds were known to congregate in the Lagoon area on sandbars. They were also attracted to this area due to the presence of outdoor seating at restaurants and people that feed birds. Bird waste may leach to storm drains or surface waters when storms occur or in other forms of urban runoff. Bird waste associated with dumpsters, trashcans, and trash that is littered can be controlled.

Employees from restaurants adjacent to the Lagoon have not been observed as rinsing bird waste off roofs in quite some time, however, they periodically pressure wash their sidewalks with water that drains to storm drains (personal communication, Steve Peters, Water Quality Specialist, Health Services Agency, County of Santa Cruz, March 30, 2006). Staff observed one esplanade restaurant employee pressure washing their patio during field reconnaissance. The Implementation Plan in Section 10 recommends methods to minimize wash water that may contain bird pathogens as a source.

4.2.2.b. Pet Waste Transport Mechanisms

According to the ribotyping analysis 21 percent of the fecal coliform present in Noble Gulch (at Blue Gum and Riverview) was from dogs. Fecal coliform from cats was also identified in Soquel Creek, to a lesser degree. Noble Gulch was narrow and fairly steep in stretches, and lacked a wide floodplain. Therefore, residences surrounding Noble Gulch were located proximal to this waterbody. Residences along Soquel Creek were also very close to the Creek in some stretches. There was the potential for residences adjacent to waterbodies in the Soquel Watershed to dispose of their pet waste by depositing it directly into the waterbody. Pet wastes can also reach these waterbodies via storm drain discharges during wet seasons. During dry seasons pet wastes can reach storm drains if wash water or excess water from other sources comes into contact with pet waste.

Staff observed several leashed dogs in Perry Park adjacent to the Lagoon during field reconnaissance (March 16, 2006). Staff observed numerous signs in this park and two additional Soquel Creek adjacent parks that advise dog walkers to pick up after their dog. Bags were also provided for picking up dog waste.

The Capitola Municipal Code includes an ordinance that requires dog owners/walkers to immediately remove and dispose of dog feces after defecation on public property (6.12.100 Public defecation). The County of Santa Cruz has a similar ordinance (6.12.080 Animal defecation prohibited where). The presence of signs and disposal bags likely helped to reduce dog waste from entering storm drain systems and ultimately the Lagoon, however, dogs continued to contribute pathogens to the Lagoon. The Implementation Plan in Section 10 recommends methods to minimize these sources.

4.2.2.c. Controllable Rodent and Wildlife Waste Transport Mechanisms

Microbial source tracking results indicated rodents and wildlife contributed bacteria to the Lagoon. Controllable rodent and wildlife waste can reach the Lagoon the same way that bird waste can reach the Lagoon. The Implementation Plan in Section 10 recommends methods to minimize this source.

4.2.2.d. Dumpster Leachate

When it rains, rainwater can enter dumpsters and discharge leachate. This occurs when dumpsters are uncovered and containers leak. During dry seasons, bird waste may reach surface waters when trash-holding areas are hosed off or washed. Wash water may reach storm water drains and surface waters.

During field reconnaissance staff observed two recycling dumpsters upside down next to a restaurant on a sidewalk over-hanging the Lagoon. The dumpsters appeared to have been hosed out with water and were drying.

The maintenance of trash receptacles in sanitary condition is in progress (*Assessment of Sources of Bacterial Contamination At Santa Cruz County Beaches,* Ricker and Peters, 2006). However, an evaluation of this program is needed. The Implementation Plan in Section 10 recommends methods to evaluate the progress of sanitary trash receptacle maintenance.

4.2.2.e. Private Laterals/Private Pump Station Spills

The SCCSD provided a report regarding videotaped sewer lines in the City of Capitola (*Capitola Video Results*, SCCSD Operations and Engineering, 2006) summarized above in Section 4.2.1. The report indicated that lateral connections to the sewer main were missing saddles (which help to make them water tight), and that the mortar (also to keep them water tight) was cracked or non-existent. Many laterals showed slime build up at the connection to the main indicating that water was leaking into the main. The report also indicated that lateral connections were leaking inwardly and outwardly and that some lateral connections were "break-in" style with lateral pipe extending into the sewer main that could have contributed to blockages. Furthermore, most of the laterals were found "low lying" with the lateral flow line below the flow line of the main with solids and standing water in the lateral. However, because the inspection only televised the sewer main it was difficult to determine the condition of the lateral pipes themselves. Rachel Lather of the SCCSD acknowledges that laterals are a problem in the Capitola Village but is uncertain as to the extent of the problem. She also said that some laterals in the Village could have been built as long ago as the 1930s (personal communication, June 26, 2006).

The SCCSD provided spill reports from 2001 to 2006. One spill in 2002 estimated at 37 gallons was the only reported spill from a private lateral. There were no spills reported from private pump stations. However, Russ Bateson, Operations Manager of the SCCSD, indicated that there were approximately 10 spills per year throughout the district (including other watersheds in addition to Soquel) from private laterals that went unreported (personal communication, June 28, 2006).

When the main is replaced or repaired, lateral connections along that section of the main are repaired by the SCCSD as well (personal communication, Diane Romeo, Sanitation Engineering, SCCSD, May 11, 2006). Repair of the sewer main was discussed in Section

4.2.1 above and is discussed in Section 10.1.1 below. The report described sections of main that were recently replaced and in good condition, but that had leaking lateral connections. These sections of main will not be replaced again until they need repair. Therefore the leaking lateral connections will not be replaced either, unless homeowners replace them.

Staff concluded it was highly probable that the laterals pipes were leaking and that the sewage was transported to the Lagoon. Furthermore, as stated in Section 4.1.1 ribotyping analysis indicated that at two Lagoon sampling stations humans generated six percent of the sampled fecal coliform. Humans were also identified as generating four percent of the fecal coliform in two stations on Noble Gulch.

The SCCSD recently adopted a Code (Santa Cruz County District Code Sections 7.04.325 and 7.04.375; March 2006) regarding sanitary sewer collection system maintenance of systems serving four or more units. Staff concludes that the ordinance may only reduce this source by a small amount as the ordinance does not address private laterals. Summarized, the Code requires that owners of such properties:

1) Maintain their sanitary sewer system to prevent overflows including flushing once during an eighteen month period;
2) Immediately stop an overflow if one occurs and have the problem repaired by a licensed plumber within five working days;
3) Report spills to the SCCSD within 24 hours and submit a written report; and
4) Certify that the sanitary sewer system was inspected prior to the sale of the house or building if the house or building was constructed, or the sewer system was inspected, more than 20 years prior to the date of sale.

The district may impose penalties of up to $2,500.00 against a property owner who fails to perform any act required in the ordinance if the spill reaches public or private property other than the property owner's property.

Staff concluded that private laterals were a likely source of pathogens in the Lagoon, and that implementation actions regarding reducing private laterals as a source are necessary. The Implementation Plan in Section 10 recommends methods to minimize this source. Staff concluded that private pump station spills were not a significant source of pathogens in the Lagoon.

4.2.3. Homeless Persons

Homeless persons generate human waste. Homeless persons and encampments were observed in the Soquel Creek Watershed. Staff concluded homeless persons were a source of human pathogens in the Lagoon. Supporting this conclusion was the finding that humans were identified as contributing four to six percent of the fecal coliform in water samples from all but one sampling station. Tamara Doan of the Coastal Watershed Council, who collects water samples in the Watershed, stopped monitoring the storm drain pipe draining Highway One to Soquel Creek in 2004 because homeless persons were living in the pipe. Personal effects believed to belong to homeless persons were

observed in 2005, however, no persons were observed. Since Doan began sampling the Soquel Watershed in 2000 there have been signs of encampments in the area directly under the North abutment of the Highway One overpass. Additionally, those working for the Coastal Watershed Council have observed "signs" of encampments from May 2000 through August 2005 in the area directly behind the Mid-County Senior Center (near sampling station Soquel Creek at Nob Hill at the upstream end of the Lagoon). The "signs" included barbeques, lawn chairs, sleeping bags, and food stashes (personal communication, April 19, 2006). Water Board Staff received information from the Capitola Police Department that evidence of homeless encampments included ground covers under shrubs in commercial areas or camping in vehicles (personal communication, Todd Mayer, Captain, Capitola Police Department, May 4, 2006; forwarded through email from Steve Jesberg, Public Works Director, City of Capitola, May 4, 2006).

Doan conversed on April 18, 2006 with a local riparian restoration biologist working on the east side of the Creek from the Soquel Creek at Nob Hill sampling station to approximately Highway One. The restoration biologist said that there were no longer any encampments on that side (the east side) of Soquel Creek. Staff concluded that although homeless persons may have moved from the area, they may return in the future or move farther upstream to less disturbed banks of the Creek. Additionally, staff observed areas of the Creek bank near Soquel Lion's Park that were flat, had riparian cover, and had relatively easy accessibility. Soquel Lion's park is approximately 0.5 mile north of the Lagoon.

According to Doan the upper watershed had more signs of temporary human use than actual homeless encampments. She observed human waste at the confluence of Soquel and Moore Creek 4.6 miles upstream of the Lagoon, in addition to an observation made at the homeless encampment sites near the Soquel Creek at Nob Hill sampling station.

Staff concluded that homeless persons were not as likely in Noble Gulch as it was visible to homeowners due to the proximity of houses and backyards to the Gulch. However, one stretch of the Gulch just south of Highway One provided better cover as it was not as visible to homeowners (personal communication, Steve Peters, Water Quality Specialist, Health Services Agency, County of Santa Cruz, April 21, 2006)).

Law enforcement cited overnight sleepers and campers. They (homeless persons) were arrested many times for outstanding drug warrants, theft warrants, or related municipal code violations. The City of Capitola Public Work department broke down large encampments (personal communication, Todd Mayer, Captain, Capitola Police Department, May 4, 2006; forwarded through email from Steve Jesberg, Public Works Director, City of Capitola, May 4, 2006).

There was no specific confirmation that homeless encampments were affecting surface waters. However, because homeless encampments were often in riparian areas and because there were no sanitary disposal facilities available for these sites, Water Board staff determined it was highly likely that human waste reached surface waters.

Additionally, as discussed in Section 3.4.1, humans were a source of the fecal coliform in the water samples collected in Soquel Creek. Staff proposes actions regarding homeless persons and encampments in the Implementation Plan in Section 10.

4.2.4. Septic System Failures

Septic systems are potential sources of fecal coliform. Staff suspected that rare septic system failures occurred at rural residences in the upper Subwatersheds of Soquel Creek, Noble Gulch, and in the Subwatershed of Bates Creek. During dry periods, sewage from failing septic systems probably did not reach a waterway unless a failure occurred close to a creek. However, on rare occasions during wet periods bacteria from failed septic systems may have flowed to ditches, roadways, creeks, and ultimately Soquel Creek.

Santa Cruz County currently has an ordinance (7.38.035 Requirement of Adequate Sewage Disposal) that requires adequate individual sewage disposal and maintenance of the individual sewage disposal system. There is currently no regular inspection of these systems. The County of Santa Cruz and the City of Capitola proposed implementing a septic systems maintenance and management program to reduce septic system failures in their draft SWMP, but an explanation of the septic systems maintenance and management program was not included. Furthermore, the Water Board will not consider approval of the SMWP until 2007.

Santa Cruz County Environmental Health Services has not analyzed septic system failures in the Soquel Watershed. However, development within in the Soquel Watershed is recent and of low density relative to development within the San Lorenzo watershed in which there is close encroachment of homes and septic systems to the San Lorenzo River. Soquel Creek generally has a wider floodplain and most of the relatively new development meets current septic standards (personal communication, John Ricker, Water Resources Program Coordinator, Health Services Agency, County of Santa Cruz, April 20, 2006).

Data collected from the West Branch Soquel Creek at San Jose at Olive Springs Road station showed very little exceedance of water quality objectives. Although Soquel Creek was considered impaired at the Porter Street Bridge sampling station, approximately 4.0 miles downstream, the exceedance of water quality objectives was low. Both stations were downstream of most of the septic systems within the watershed, however, the Porter Street Bridge station was also downstream of higher density urban development. Data was not collected at any other station within the four-mile reach between the two stations. Never the less these findings supported the conclusion that information indicating that septics were a source of pathogens in the Lagoon was lacking. Staff concluded that until evidence indicates that septic systems are a source of pathogens in the Lagoon, methods to minimize septic systems as a source are not required.

4.2.5. Farm Animals and Livestock

Land use analysis indicated that 121 acres of the Soquel Watershed was covered by pastureland or hay (areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops). Approximately 92 percent of this total was within the watershed of Bates Creek.

According to Steve Peters, Water Quality Specialist, Health Services Agency, County of Santa Cruz, there were horses in residence on the north side of Highway One east of Noble Gulch between Silver Birch and Monterey Ave. within the Noble Gulch watershed (personal communication, April 13 and July 5, 2006). Peters also observed horses above Soquel Drive around Victory Lane and Cunnison Lane. Water Board staff observed cattle on Cunnison Lane West of Noble Gulch.

Furthermore, staff observed horses in proximity to the Soquel Creek flood plain during field reconnaissance. During the same field visit staff also noted that chickens, roosters, and cattle were present along Soquel San Jose Road which is adjacent to the Soquel Flood plain in some stretches. John Ricker, Water Resources Program Coordinator, Health Services Agency, County of Santa Cruz, estimates that there may be 400 to 600 head livestock in the Soquel watershed in the document *Assessment of Sources of Bacterial Contamination At Santa Cruz County Beaches* (Ricker and Peters, 2006).

The ribotyping analysis used in this report indicated that approximately one percent of the contribution of fecal coliform originated from horse at one sampling location in both Soquel Creek and Noble Gulch. There was no fecal coliform from cow identified in the sampling. However, there was no wet season sampling conducted at the Noble Gulch sampling station. Also, the wet season information for Soquel Creek at Nob Hill was based on only 22 isolates from only two days of wet season sampling. As stated above, reliable bacteria analysis should include 50 – 100 isolates collected from one location over time. Therefore more contribution from horses as well as cattle may have been identified if sampling was more robust and conducted during the wet season. Additionally, there is substantial evidence from other watersheds that when cattle are present in the watershed fecal coliform from cows travels to the respective waterbody.

Staff concluded that horses contributed pathogens and other farm animals are suspected of having contributed pathogens to the Soquel Lagoon. Waste from horses is controllable and therefore staff is proposing actions in the Implementation Plan contained in Section 10 of this report to control horse waste. Waste from cows and other farm animals, is also controllable. The actions required for horses addresses waste from these other animals as well.

4.3 Natural Sources

The Water Board has authority to regulate waste discharges. The Water Board does not have authority to regulate natural sources from wildlife.

Birds, wildlife (e.g. raccoon, deer, and opossum), and rodent were the largest sources of fecal coliform in the Lagoon. Birds made up between 36 percent and 64 percent, wildlife contributed between seven percent and 31 percent, and rodents contributed between seven percent and 14 percent of the fecal coliform at all five sampling sites combined based on ribotyping analysis. Bird wastes entered the Lagoon from roosting areas in proximity to the Lagoon or upstream waters. Wildlife and rodent droppings in proximity to the Lagoon or upstream waters also contributed fecal coliform.

These sources are not subject to waste discharge regulation by the Water Board. Agencies in charge of land use have authority to require practices that reduce contributions from these sources. For example, cities can require landowners to install devices that prevent bird-landing areas. Such devices could reduce the quantity of bird excrement that reaches surface waters during storms or during washing of sidewalks or other surfaces.

As mentioned earlier, the Water Board does have the authority to regulate natural sources, such as birds, if waste enters the surface waters by human means such as through wash water.

4.4 Source Analysis Conclusions

Staff concluded the largest contributors to the bacteria in the Soquel Lagoon were natural sources (bird, wildlife, and rodent) as discussed above in Section 4.3 Natural Sources. Staff estimated most of the bird, rodent, and wildlife waste is natural or not controllable.

Staff determined the relative order of controllable sources that contributed bacteria to the Soquel Lagoon. They are listed here in relative order beginning with the largest source first: 1) Storm Drain Discharges; 2) Sewage Spill and Leaks; 3) Farm Animals and Livestock; and 4) Homeless Persons. The order was based on the information in Sections 3 and 4 of this report. As stated previously, staff used water quality data, discharger data and reports, flow estimates, land use data, ribotyping results, field reconnaissance work, and conversations with County staff to complete the source analysis conclusions.

Storm drain discharges likely contributed the most bacteria to the Soquel Lagoon. First of all, land from which storm water runoff was generated was larger than the total land containing any of the other sources named below. Many contributors to stormwater bacteria, including the four likely greatest contributors based on ribotyping analysis (birds, wildlife, rodents, and dogs), lived within urban land which was the second largest land use in the watershed and the largest land use surrounding the Lagoon. Storm drains

from this urban land emptied into the reaches of Soquel Creek in which impairment occurred.

Sewage spills and leaks were likely the second greatest contributor of bacteria in the Lagoon. Based on video analysis performed by the SCCSD, the sewer collection system was determined to leak in proximity of the Lagoon. Furthermore, old pipes exist throughout the City of Capitola. Stormwater and subsurface flow was suspected of carrying this sewage to the Lagoon. Staff concluded that because it was known that the system was leaking and the majority of the known leaking sections were in the proximity of the Lagoon, this was a greater source of bacteria to the Lagoon than the remaining two sources of livestock and homeless. Furthermore, system spills reached the Lagoon in 2002, 2003, and 2004 and human DNA was identified in the Lagoon downstream of areas of the watershed containing the sewer collection system.

Staff concluded farm animals and livestock (livestock), and homeless persons were not as great a source of bacteria to the Lagoon as the above sources. The lower ranking of livestock was partly based on ribotyping analysis through which their contribution to bacteria was identified as one percent in both Soquel Creek and Noble Gulch. Additionally, the known areas containing livestock in the watershed were few. Livestock were ranked slightly higher than homeless because staff identified more specific areas known to contain livestock than areas containing homeless persons. Furthermore, livestock are typically more permanent in their locations relative to homeless persons who are of a transient nature.

Although human DNA found in the lagoon may have come from homeless persons and not from the other above sources and although the bacterial contribution of homeless living in riparian areas was more direct when it occurred, the number of homeless was uncertain and their encampments may have been temporary, thus staff concluded they contributed less bacteria to the lagoon than the above sources.

5. CRITICAL CONDITIONS AND SEASONAL VARIATION

This section discusses factors affecting impairment, critical conditions, and seasonal fecal coliform variations.

5.1. Critical Conditions

Many factors contributed to the Soquel Lagoon impairment. These factors included the following: 1) discharge of pathogens to waterbodies in the Soquel Watershed; 2) stream flow transmission; and 3) survival and possible instream fecal coliform population growth.

There are several uncertainties with pathogens. Stream flows may serve to either increase or dilute fecal coliform concentrations. Stagnant pools may be areas where fecal coliform increases due to evaporation. Staff found no specific evidence that these or other conditions were critical.

5.2. Seasonal Variations

Staff analyzed Soquel Creek and Noble Gulch fecal coliform data on a seasonal basis (Table 5-1). Data from sampling stations without enough data to detect a seasonal trend were not included. Staff considered monthly water quality objective exceedances. The table provides seasonal trend conclusions for three sampling stations in the Soquel Watershed. The three stations were the only stations from which enough data was collected in order to consider seasonal trends.

Table 5-1. Soquel Creek and Noble Gulch Seasonal Analysis

Station	Water Quality Objective	Months Exceeding Water Quality Objective	Comments
Soquel Creek at Flume Outlet	Fecal Coliform Geomean=200 MPN/100 ml	Mean: All months	No seasonal trend.
		Median: All months	
	Fecal Coliform not to Exceed=400 MPN/100 ml	Mean: All months except April	
		Median: May to Dec.	
Soquel Creek at Railroad Trestle	Fecal Coliform Geomean=200 MPN/100 ml	Mean: June, Oct., Nov., Dec.	No seasonal trend.
		Median: Jan., June, Oct., Nov., Dec.	
Noble Gulch at St. Joe's Church	Fecal Coliform not to Exceed=400 MPN/100 ml	Mean: Feb., March, April, May, Sep., Nov., and Dec.	No seasonal trend.
		Median: Feb., March, April, May, Sep., Nov., and Dec.	

Seasonal trends were not detected at the three sampling stations. Staff noted that although all months exceeded the geometric mean water quality objective from 2003 to 2006 at the Soquel Creek at Flume Outlet sampling station, the months of June through December were consistently higher (see Appendix 2). There was relatively little precipitation for the months of June through November compared to the remaining months from 2003 to 2006. Fecal coliform levels could have risen in the Lagoon during this time due to lack of circulation and dilution from stormwater runoff. Although rain increased in December (which is included in the period of higher fecal coliform levels) from 2003 to 2006, the first flush of stormwater runoff typically transports the highest levels of fecal coliform off of the land.

The implementation strategy in Section 10 will not change due to the higher levels in one part of the year versus another as in this case. The objective was exceeded during each month of the year, and therefore must be addressed each month of the year.

5.3. Conclusion

Though several conditions potentially account for the documented impairment, staff concluded there were no critical conditions or significant seasonal variations. Therefore, staff did not adjust load allocations and numeric targets to account for critical conditions or seasonal variations.

6. NUMERIC TARGET

The Basin Plan contains fecal coliform water quality objectives. The fecal coliform numeric targets for Soquel Lagoon is based on current Basin Plan water contact recreation objectives and the Unites States Environmental Protection Agency (USEPA) water quality criteria.

Table 6-1. Soquel Creek and Noble Gulch Seasonal Analysis

Fecal Coliform[a]		*E.coli*[b]	
Geometric Mean[c]	Maximum[d]	Geometric Mean[c]	Maximum[d]
200 MPN/100 mL	400 MPN/100 mL	126 MPN/100 mL[e]	235 MPN/100 mL[f]

[a] Existing Water Quality Objective for Water Contact Recreation Beneficial Use
[b.] USEPA Ambient Water Quality Criteria for Bacteria-1986
c Geometric mean of not less than five samples over a period of 30 days
d. Not more than 10% of total samples during a period of 30 days exceed
e. Calculated to nearest whole number using equation: geometric mean = antilog10 [(risk level + 11.74) / 9.40].
f: Calculated using the following: single sample maximum = geometric mean * 10^(confidence level factor * log standard deviation), where the confidence level factor is: 75%: 0.68; 82%: 0.94; 90%: 1.28; 95%: 1.65. The log standard deviation from EPA's epidemiological studies is 0.4 for fresh waters.

Staff proposes removal of the shellfish beneficial use for the Soquel Lagoon from the Basin Plan. (See the Use Attainability Analysis in Appendix Five.) Therefore, staff is not proposing numerical targets related to shellfish harvesting.

Should all control measures be in place and fecal coliform levels remain high, investigations (e.g., genetic studies to isolate sources or other appropriate monitoring) will take place to determine if the high level of fecal coliform is due to uncontrollable sources. Responsible parties will demonstrate that controllable sources of fecal coliform are not contributing to exceedance of water quality objectives in receiving waters. If this is the case, staff will consider re-evaluating the targets and allocations. For example, staff may propose a site-specific objective to be approved by the Water Board. The site-specific objective would be based on evidence that natural, or "background" sources alone were the cause of exceedances of the Basin Plan water quality objective for fecal coliform.

7. LINKAGE ANALYSIS

The goal of the linkage analysis is to establish a link between pollutant loads and water quality. This, in turn, supports that the loading capacity specified in the TMDL will result in attaining the numeric target. For this TMDL, this link is established because the numeric target concentrations are the same as the TMDL, expressed as a concentration. Sources of bacteria have been identified that cause the elevated concentrations of bacteria in the receiving water body. Therefore, reductions in bacteria loading from these sources should cause a reduction in the bacteria concentrations measured. The numeric targets are protective of the recreational beneficial uses, hence the TMDL defines appropriate water quality.

8. TMDL CALCULATION AND ALLOCATIONS

A TMDL is the pollutant loading capacity that a water body can accept while protecting beneficial uses. Usually, TMDLs are expressed as loads (mass of pollutant calculated from concentration multiplied by the volumetric flow rate), but in the case of pathogens, it is more logical for the TMDL to be expressed as a concentration. TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure [40 CFR §130.2(I)]. A concentration TMDL makes more sense in this situation because the public health risks associated with recreating in contaminated waters scales with organism concentration, and pathogens are not readily controlled on a mass basis. Therefore, we are establishing the TMDL as a concentration for pathogens in the Soquel Lagoon.

Staff proposes the TMDL as the same set of concentrations as staff proposed in the numeric targets section.

Table 8-1. TMDL for Soquel Lagoon

Fecal Coliform[a]		*E.coli*[b]	
Geometric Mean[c]	**Maximum[d]**	**Geometric Mean[c]**	**Maximum[d]**
200 MPN/100 mL	400 MPN/100 mL	126 MPN/100 mL[e]	235 MPN/100 mL[f]

[a] Existing Water Quality Objective for Water Contact Recreation Beneficial Use
[b.] USEPA Ambient Water Quality Criteria for Bacteria-1986
c Geometric mean of not less than five samples over a period of 30 days
d. Not more than 10% of total samples during a period of 30 days exceed
e. Calculated to nearest whole number using equation: geometric mean = antilog10 [(risk level + 11.74) / 9.40].
f: Calculated using the following: single sample maximum = geometric mean * 10^(confidence level factor * log standard deviation), where the confidence level factor is: 75%: 0.68; 82%: 0.94; 90%: 1.28; 95%: 1.65. The log standard deviation from EPA's epidemiological studies is 0.4 for fresh waters.

8.1. Wasteload and Load Allocations

The allocation for each non-natural (controllable) source and corresponding responsible party is equal to the TMDL concentration shown in Table 8-1. The allocation is the same for each responsible party. The responsible party shall not discharge or release a "load" of bacteria that will increase the bacteria concentration above the assimilative capacity or TMDL concentration of the water body. The parties responsible for the allocation to non-natural (controllable) sources are not responsible for the allocation to natural (uncontrollable) sources.

Table 8-2. Allocations and Responsible Parties

Waterbody	Responsible Party and Source	Receiving Water Fecal Coliform (MPN/100ml)	Receiving Water *E. Coli* (MPN/100ml)
WASTE LOAD ALLOCATIONS			
Soquel Creek and Noble Gulch	Santa Cruz County and City of Capitola (Stormwater Discharges)	≤ 200[1] and 400[2]	≤ 126[1] and 235[2]
LOAD ALLOCATIONS			
Soquel Creek and Noble Gulch	Santa Cruz County Sanitation District (Sewage Spills and Leaks))	≤ 200[1] and 400[2]	≤ 126[1] and 235[2]
Soquel Creek and Noble Gulch	Landowners with Homeless Persons (Homeless Persons)	≤ 200[1] and 400[2]	≤ 126[1] and 235[2]
Soquel Creek and Noble Gulch	Operators or Owners of Livestock Facilities and Livestock (Livestock)	≤ 200[1] and 400[2]	≤ 126[1] and 235[2]
Soquel Creek and Noble Gulch	Natural Sources	≤ 200[1] and 400[2]	≤ 126[1] and 235[2]

[1] As log mean of five (5) samples taken in a 30-day period.
[2] As a maximum with not more that 10% exceedance during 30-day period.

When a responsible party implements the control measures (including monitoring and submittal of documentation) required herein, staff will assume that they have attained their respective allocation. Should all control measures be in place and fecal coliform levels remain high, investigations (e.g., genetic studies to isolate sources or other appropriate monitoring) will take place to determine if the high level of fecal coliform is due to uncontrollable sources. Responsible parties will demonstrate that controllable sources of fecal coliform are not contributing to exceedance of water quality objectives in receiving waters. If this is the case, staff will consider re-evaluating the targets and allocations. For example, staff may propose a site-specific objective to be approved by the Water Board. The site-specific objective would be based on evidence that natural, or "background" sources alone were the cause of exceedances of the Basin Plan water quality objective for fecal coliform.

8.2. Margin of Safety

The TMDL requires a margin of safety component that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving water (CWA 303(d)(1)(C)). For pathogens in the Soquel Lagoon, a margin of safety has been established implicitly through the use of protective numeric targets, which are in this case the water quality objectives for the Soquel Lagoon beneficial uses.

The pathogen TMDL for the Soquel Lagoon is the water quality objective for water contact recreation. The Central Coast Region Water Quality Control Plan states that, "controllable water quality shall conform to the water quality objectives. When other conditions cause degradation of water quality beyond the levels or limits established as water quality objectives, controllable conditions shall not cause further degradation of water quality" (Basin Plan, p. III-2). Because the allocation for controllable sources is set at the water quality objective, if achieved, these allocations will by definition contribute as much as possible to achieving the water quality objectives in the receiving water. Thus, in this TMDL there is no uncertainty relative to the load effect from controlled sources on water quality.

However, in certain locations there is a distinct possibility that non-controllable, or, natural sources will themselves occur at levels exceeding water quality objectives. And while it is controllable water quality conditions ("actions or circumstances resulting from man's activities" (Basin Plan, p. III-2)) that must conform to water quality objectives, receiving water quality will contain discharge from both controllable and natural sources.

The ability to differentiate the controllable from the natural sources is the chief uncertainty in this TMDL. The ribotyping method used in this report is one of the best methods available, but it is not 100 percent accurate. This ribotyping method results in greater variability of false positive rates among genotypic library-based methods, with incorrect classification ranging from 25-75% (John F. Griffith, Stephen B. Weisberg, Charles D. McGee 2003).

Additionally, these data, which confirmed the presence of natural sources, do not estimate loads; they only provide the relative percent of samples that indicated the type of source. Reporting and monitoring will indicate whether the allocations from controllable sources are met, thereby minimizing any uncertainty about the impacts of loads on the water quality.

9. PUBLIC PARTICIPATION

Public participation began when the County developed a report required by Proposition 13 Grant Funds. The grant required a Technical Advisory Committee (TAC) to meet periodically.

Staff communicated with key personnel from the County of Santa Cruz, County of Santa Cruz Sanitation District, Coastal Watershed Council, and City of Capitola.

Water Board staff presented TMDL project report results at two meetings. Water Board staff solicited comments at both these meetings. One meeting was held during the early phase of Water Board project plan development on November 16, 2005. At the second meeting, on June 26, 2006, Water Board staff presented preliminary project report findings. Water Board staff incorporated public comments into this document where appropriate. Staff also scoped issues pursuant to the California Environmental Quality Act at this meeting. Staff will prepare environmental documents indicating any potential environmental impacts and considering alternative allocations schemes or implementation strategies prior to soliciting formal public comments on this TMDL and implementation plan.

Water Board staff will solicit public comments before the Water Board public hearing to consider adoption of a Soquel Lagoon TMDL. The Water Board will also accept public comments at the Water Board public hearing.

10. IMPLEMENTATION PLAN

The purpose of the Implementation Plan is to describe the steps necessary to reduce pathogen loads and to achieve this TMDL. The Implementation Plan identifies the following: 1) actions expected to reduce pathogen loading; 2) parties responsible for taking these actions; 3) regulatory mechanisms by which the Water Board will assure these actions are taken; 4) reporting and evaluation requirements that will indicate progress toward completing the actions; 5) and a timeline for completion of implementation actions. A monitoring plan designed to measure progress toward water quality goals is included in the following section.

The Implementation Plan incorporates requirements that currently exist or are proposed pursuant to an existing regulatory mechanism (e.g. permit or prohibition). As such, no new regulations are required and the Water Board's Executive Officer is authorized to take the proposed steps to insure implementation of appropriate actions to reduce pathogen loading.

Staff differentiated existing versus proposed requirements as presented below.

10.1. Implementation Actions

Staff discusses the proposed actions necessary for the water bodies to attain bacteria water quality standards in this section. The actions are presented by the sources of bacteria to the Soquel Lagoon.

Table 10-1 in Section 10.2 provides a summary of required implementation tasks.

The following discussion provides detailed information regarding requirements to attain the TMDL.

10.1.1. Storm Drain Discharges

The State Water Resources Control Board adopted an NPDES General Permit for storm water discharge. The General Permit requires smaller State municipal dischargers, such as the County of Santa Cruz and the City of Capitola, to develop and implement a Storm Water Management Program (SWMP). The SWMP goal is to reduce pollutant discharge to the maximum extent practicable. The management programs must specify what best management practices the municipality will use to address certain program areas. The program areas include public education and outreach; public involvement and participation; illicit discharge detection and elimination; construction and post-construction stormwater runoff management; and good housekeeping for municipal operations. The County will be required to report annually on the status of implementation of measures to control bacteria in stormwater.

At the time of writing this report, the Water Board has not approved a SWMP for the County of Santa Cruz.

Water Board staff proposes all controllable sources be controlled to the maximum extent practicable.

The General Permit requires the permittee to submit annual reports. The annual report must specify measurable goals for the following year. The annual report will also contain monitoring information. The permittee will include information such as visual monitoring or tracking information to determine if measurable goals were attained during the previous year. The annual report will also evaluate actions the permittee implemented during the previous year and propose changes for the following year.

Water Board staff will review annual reports and assess if management practices were implemented and measurable goals were attained. If Water Board staff determines the permittee's actions were unsatisfactory, the Water Board will initiate and complete standard enforcement protocol to require permit compliance.

Staff proposes the Agencies identify the specific sources that contribute pathogens to surface waters. The Agencies should identify and implement public participation and outreach management measures. The Agencies must develop and implement enforceable means of reducing fecal coliform loading to storm water. The Storm Water Management Plan must include the mechanisms for reaching specific target source groups. Some preventative management measures individuals can use include:

1. Eliminate over watering and runoff of irrigation water into the street;
2. Require cars to be washed only at carwashes or to be washed at locations where runoff will not run into the street;
3. Require discharges of wash water from carpet cleaning, mop buckets, floor mat washing, etc. to be discharged to the sanitary sewer;
4. Require spill clean up with mops or absorbent material rather that washing into a gutter or storm drain inlet; and
5. Install anti-microbial filter fabrics in storm drains.

Staff proposes the Agencies continue to maintain a street sweeping program to help prevent bacteria from reaching storm drains. Low impact development principles should be applied to new and redevelopment to minimize and prevent addition of new sources.

10.1.1.a. Proposed Storm Water Management Plan Requirements for County of Santa Cruz and City of Capitola (Agencies): Pet Wastes

The Agencies must take actions to reduce pet waste loading. As stated above in Section 4.2.2.c., the County of Santa Cruz has an ordinance enforcing pet waste pick-up and the City of Capitola has an ordinance enforcing dog waste pick-up. While these ordinances are commonly enforced in public places, pet waste, including waste from cats, on a pet

owner's property or residence may also be at risk of entering waterbodies (e.g. backyards abutting waterways, or dog defecation directly in waterbody) if not disposed of properly. Therefore, the Agencies should undertake additional measures to educate residents and homeowners whose properties abut riparian areas and waterbodies regarding the vulnerability of these areas to pollution from domestic dog, cat, and other pet waste.

10.1.1.b. Proposed Storm Water Management Plan Requirements for County of Santa Cruz and City of Capitola (Agencies): Dumpster Leachate and Controllable Rodent, Bird, and Other Wildlife Waste

Staff proposes the County include management practices that specifically address dumpsters/receptacles serving restaurants or other facilities within the agencies' jurisdiction to eliminate discharge leachate. Additionally, the County must consider ways to eliminate other controllable sources from rodents, birds, or other wildlife. For example, the County should require that dumpsters always be covered and be replaced when leaks occur. The County should report on status of addressing this source and implementing practices in their annual report once they have an approved Storm Water Management Plan.

10.1.1.c. Proposed Storm Water Management Plan Requirements for County of Santa Cruz and City of Capitola (Agencies): Private Laterals

The County must evaluate the contributions of bacteria from private laterals and develop appropriate measures to reduce bacteria loading from private laterals

10.1.1.d. Proposed Storm Water Management Plan Requirements for County of Santa Cruz and City of Capitola (Agencies): Proposed Public Education

Santa Cruz County must identify how they will educate the public, what best management practices the County will use to educate the public, and goals for the public education and outreach program. The County should specifically target education to landowners regarding management measures to minimize leaks from private laterals and homeless encampment discharges.

10.1.1.e. Storm Water Management Plan Requirements for the County of Santa Cruz: New Development

The County must develop and implement low impact development principles and practices for new and redevelopment to minimize and prevent addition of new sources.

10.1.2. Homeless Encampments and Farm Animals/Livestock

Homeless encampments must comply with the existing discharge prohibition for the

Soquel Creek watershed.

Law enforcement officers are utilized to remove homeless encampments. However, removal can take up to a year. After homeless encampments are removed, homeless encampments often relocate to other sites. Therefore, the discharge of waste from homeless encampments continues. Existing law enforcement efforts are not resulting in decreases of waste from homeless encampments.

Staff proposes to require landowners whose land supports homeless encampments to develop and implement strategies to reduce/eliminate bacteria loading from these encampments. Staff also proposes landowners submit documentation to Water Board staff showing no discharge is occurring from encampments. Staff will work with landowners and agency staff to develop documentation details during the staff implementation tracking phase that occurs after the TMDL is adopted.

As shown earlier in this report, horses contribute a small portion of the fecal coliform to the Watershed. Other potential farm animal sources include emu, goat, chicken and other livestock. Santa Cruz County Environmental Health Department has had success with runoff and manure management at many of the larger operations.

The *Nonpoint Source Implementation and Enforcement Policy*, adopted as state law in August 2004, requires the Regional Water Boards to regulate all nonpoint sources (NPS) of pollution using the administrative permitting authorities provided by the Porter-Cologne Act. Nonpoint source dischargers must comply with Waste Discharge Requirements (WDRs), waivers of WDRs, or Basin Plan Prohibitions by participating in the development and implementation of Nonpoint Source Pollution Control Implementation Programs. NPS dischargers can comply either individually or collectively as participants in third-party coalitions. (The "third-party" Programs are restricted to entities that are not actual discharges under Regional Water Board permitting and enforcement jurisdiction. These may include Non-Governmental Organizations, citizen groups, industry groups, Watershed coalitions, government agencies, or any mix of the above.) All Programs must meet the requirements of the following five key elements described in the NPS Implementation and Enforcement Policy. Each Program must be endorsed or approved by the Regional Water Board or the Executive Officer (where the Regional Water Board has delegated authority to the Executive Officer).

Key Element 1: A Nonpoint Source Pollution Control Implementation Program's ultimate purpose must be explicitly stated and at a minimum address NPS pollution control in a manner that achieves and maintains water quality objectives.

Key Element 2: The Program shall include a description of the management practices (MPs) and other program elements dischargers expect to implement, along with an evaluation program that ensures proper implementation and verification.

Key Element 3: The Program shall include a time schedule and quantifiable milestones, should the Regional Water Board require these.

Key Element 4: The Program shall include sufficient feedback mechanisms so that the Regional Water Board, dischargers, and the public can determine if the implementation program is achieving its stated purpose(s), or whether additional or different MPs or other actions are required (See Section 10, Monitoring Program).

Key Element 5: Each Regional Water Board shall make clear, in advance, the potential consequences for failure to achieve a Program's objectives, emphasizing that it is the responsibility of individual dischargers to take all necessary implementation actions to meet water quality requirements.

Requirements for Landowners: Farm Animals/Livestock

Operators and/or owners of farm animals/livestock must comply with the existing discharge prohibition for the Soquel Creek Watershed.

Staff recommends operators and/or owners of livestock facilities and animals develop and implement strategies to reduce and/or eliminate fecal coliform loading. The Executive Officer will require operators and/or owners of livestock facilities and animals to prepare and submit plans that assess their contribution to bacterial loading and describe steps they are or will take to insure any bacterial loading is minimized or eliminated. The plans should address the elements of the Nonpoint Source Pollution Control Implementation Program.

Ecology Action has obtained Proposition 13 Grant Funds to improve water quality discharges resulting from livestock operations. The Grant includes the following tasks: (1) workshops to present pollution prevention approaches, (2) a pollution reduction demonstration, (3) peer recognition at an awards ceremony for facilities that have implemented or maintained exemplary management practices, and (4) a Feasibility and Market Study or a pilot manure hauling/composting service. This project is a joint effort of the Ecology Action, Santa Cruz County Resource Conservation District, and the Santa Cruz Horsemen's Association.

The NPS policy requires regulation of these farm animal/livestock sources. The work performed by Ecology Action may evolve into a "third-party" program. As discussed above, dischargers may either individually or collectively, as participants in third-party coalitions, insure waste discharge programs are consistent with the NPS program elements.

County of Santa Cruz zoning regulations state that the use of stables, paddocks, or corrals must be accompanied by an erosion control plan prepared pursuant to Section 16.22.060 of County Planning and Zoning Regulations. Because rainfall runoff transports sediment and manure similarly, compliance with these County regulations could result in at least partial completion of this TMDL Implementation Action. However, additional measures are required for facilities that allow non-sterile manure to come into contact with rainwater and enter surface waters through runoff. Through preparation of a Nonpoint Source Pollution Control Implementation Program operators or owners of such facilities

could identify non-sterile manure management measures. Possible management measures include:

- Runoff management, including diversion of clean water from contact with holding pens, animals, and manure storage facilities through the use of berms, diversions, roofs, or enclosures;
- Grass waterways;
- Critical plantings;
- Filter strips;
- Composting manure; and
- Daily clean up.

10.2. Summary of Required Actions

Table 10-1 outlines the schedule of required implementation actions. The actions in the table below represent minimum actions and schedules required. The Water Board may, at its discretion, alter the tasks defined below if sufficient water quality improvements are not realized. The Water Board will make modifications to the tasks listed below pursuant to, but not limited to, the regulatory mechanisms articulated in the table. Also note that tasks requiring monitoring activities refer to monitoring efforts that are described in the Monitoring Plan, which is outlined in Section 11 of this document.

Table 10-1. Schedule and Trackable Implementation Actions

Implementing Party	Sources	Regulatory Mechanism(s)	Actions of Implementing Party	Schedule of Action(s)
Santa Cruz County and the City of Capitola	Storm Drain Discharges	Anticipated Small MS4 Permit	1. SWMP: The County and City (as co-permittees of the SWMP) will implement actions (including addressing urban runoff; pet wastes; dumpster leachate; controllable rodent, bird, and wildlife waste; and public education) to reduce fecal coliform loading from urban sources. 2. Annual Report: The County and City (as co-permittees of the SWMP) will report specific measures that have and/or will be taken to reduce fecal coliform loading from urban sources. The Report will provide demonstration that fecal coliform concentrations from the storm drain were reduced to the maximum extent practicable. 3. Monitoring: The County of Santa Cruz and City of Capitola will implement the monitoring requirements in Section 11.	1. The County and City (as co-permittees of the SWMP) will submit an Annual Report within one year after SWMP adoption by the Water Board. 2. The Water Board staff will review the Annual Report and require changes to insure reduction in bacteria loading, if necessary.

Implementing Party	Sources	Regulatory Mechanism(s)	Actions of Implementing Party	Schedule of Action(s)
Landowners with farm animals and livestock	Farm Animals/Livestock	1. Basin Plan Discharge Prohibition OR 2. Waste Discharge Requirements or Waiver of Waste Discharge Requirements.	1. Submit documentation demonstrating elimination of discharges that complies with Basin Plan Prohibition OR submit Nonpoint Source Implementation program that can serve as basis of WDRs or Waiver of WDRs: Landowners will 1) develop, implement, and document strategies to eliminate fecal coliform loading from farm animal and livestock facilities (e.g., pens, corrals, barns) into surface waters of the Soquel Lagoon Watershed; or 2) landowners will document to the Executive Officer of the Water Board that land activities do not cause waste to pass into waters of the state; 2. Triennial Report: All landowners shall submit a Triennial Report documenting that measures are in place and effectively minimizing discharges or demonstrating that no discharge is occurring from animal facilities. 3. Monitoring: Landowners with farm animals and livestock will implement monitoring requirements that will be determined during the TMDL implementation phase.	1. Within six months of receiving a Water Board request, landowners will provide documentation demonstrating waste discharges are not occurring OR submit Nonpoint Source Implementation Programs. 2. The Water Board staff will review the Triennial Report and require changes to insure reduction in bacteria loading, if necessary.

Implementing Party	Sources	Regulatory Mechanism(s)	Actions of Implementing Party	Schedule of Action(s)
Landowners with homeless encampments	Homeless Encampment Waste	1. Basin Plan Discharge Prohibition OR 2. Waste Discharge Requirements or Waiver of Waste Discharge Requirements.	1. Submit documentation demonstrating elimination of discharges that complies with Basin Plan Prohibition OR submit Nonpoint Source Implementation program that can serve as basis of WDRs or Waiver of WDRs: Landowners will 1) develop, implement, and document strategies to eliminate fecal coliform loading into surface waters of the Soquel Creek Watershed; or 2) landowners will document to the Executive Officer of the Water Board that land activities do not cause waste to pass into waters of the state. 2. Triennial Report: All landowners shall submit a Triennial Report demonstrating that no discharge is occurring from homeless encampments. 3. Monitoring: Landowners with homeless encampments will implement monitoring requirements that will be determined during the TMDL implementation phase.	1. Within six months of receiving a Water Board request, landowners will provide documentation demonstrating waste discharges are not occurring OR submit Nonpoint Source Implementation Programs. 2. The Water Board staff will review the Triennial Report and require changes to insure reduction in bacteria loading, if necessary.

10.3. Evaluation of Implementation Progress

Water Board staff will conduct a review of implementation actions according to the schedule identified in Table 10-1. Water Board staff will use annual reports, NPS Pollution Control Implementation Programs, as well as other available information, to review water quality data and implementation efforts as well as overall progress toward achieving the allocations and the numeric target.

Water Board staff may conclude that ongoing implementation efforts are insufficient to ultimately achieve the allocations and numeric target. If staff makes this determination, staff will recommend that additional reporting, monitoring, or implementation efforts be required either through approval by the Executive Officer (e.g. pursuant to Section 13267 or Section 13383 of the California Water Code) or by the Water Board (e.g. through

revisions of existing permits and/or a Basin Plan Amendment). Staff may conclude that at the time of review they expect implementation efforts to result in achieving the allocations and numeric target. In that case, existing and anticipated implementation efforts should continue. Water Board reviews will continue until the TMDL is achieved.

Responsible implementing parties identified in Table 10-1 will monitor according to the proposed monitoring plan (see Section 11) for at least three years, at which time Water Board staff will determine the need for continuing or otherwise modifying the monitoring requirements. If it is demonstrated that controllable sources of pathogens are not contributing to exceedance of water quality objectives in receiving waters, staff will consider modifying numeric targets and/or allocations. This may result, for example, in staff establishing a new site-specific objective for the Soquel Lagoon. The site-specific objective would be based on evidence that natural, or "background" sources alone were the cause of exceedances of the Basin Plan water quality objective for fecal coliform.

10.4. Timeline and Milestones

Staff anticipates that the allocations, and therefore TMDL, will be achieved 10 years from the date of TMDL approval. The estimation is based on the cost and difficulty inherent in identifying fecal coliform/*E. coli* sources from all sources. The estimation is also based on the uncertainty of the time required for water quality improvements resulting from best management practices to be realized. Small Storm Water Management Plan permits outline a 5-year schedule for full implementation of best management practices (BMPs) and activities. In general, storm water BMPs are designed to achieve compliance with water quality standards to the maximum extent practicable through an iterative process.

Staff anticipates that the full in-stream positive effect of all the management measures will be realized gradually. Staff therefore set a goal for TMDL attainment of 10 years after TMDL adoption. In addition, storm water permits or nonpoint source implementation programs may include additional provisions that the Water Board determines are necessary to control pollutants (CWA section 402(p)(3)(B)(iii)). The Water Board will consider additional requirements if implementation of management practices do not result in achievement of water quality objectives.

11. MONITORING PLAN

11.1. Introduction

The Monitoring Plan outlines the monitoring sites, frequency of monitoring, and parties responsible for monitoring. The monitoring for TMDL compliance and evaluation is the minimum staff believes is necessary. However, if a change in these requirements is warranted after the TMDL is approved, the Executive Officer and/or the Water Board will require such changes.

11.2. Monitoring Sites, Frequency, and Responsible Parties

Water Board staff proposes fecal coliform and *E. coli* monitoring in receiving waters at the following stations:

- Soquel Lagoon at Flume Outlet/Inlet
- Soquel Creek above Noble Gulch
- Soquel Creek at 2525 Main Street
- Soquel Creek at Bates Creek
- Noble Gulch at Soquel Creek
- Noble Gulch at Highway One
- Noble Gulch at Victory Lane/Coyote Canyon

In addition to the receiving water locations, staff also proposes fecal coliform and *E. coli* monitoring in stormwater at the Monterey Ave. station. This is the same station sampled by the CWC located along Monterey Avenue approximately 0.6 mile east of the Lagoon and approximately 100 feet southwest of Noble Gulch. The City of Capitola and the County of Santa Cruz will identify additional stormwater outfall locations at which stormwater will be sampled and analyzed for fecal coliform and *E. coli.*

Table 11-1. Monitoring Required
11-1 below identifies the responsible party, monitoring site, sampling period, number of samples, and constituent. Most stations have more than one responsible party indicated for monitoring. This reflects the fact that multiple parties are known, or, potential sources of pathogens and thus share responsibility for monitoring. The responsible party must provide the data to the Water Board in subsequent annual reports required by existing Waste Discharge Requirements, the Small MS4 Permit, or in a separate technical report.

Table 11-1. Monitoring Required

Responsible Party	Monitoring Site	Sampling Period[1]	Number of Samples	Constituent (#/100 mL)
RECEIVING WATER MONITORING				
City of Capitola, Santa Cruz County	Soquel Lagoon at Flume Outlet	Monthly	12[2]	Fecal Coliform and *E. coli*
City of Capitola, Santa Cruz County	Soquel Creek above Noble Gulch	Monthly	12[2]	Fecal Coliform and *E. coli*
City of Capitola, Santa Cruz County	Soquel Creek at 2525 Main Street	Monthly	12[2]	Fecal Coliform and *E. coli*
City of Capitola, Santa Cruz County	Soquel Creek at Bates Creek	Monthly	12[2]	Fecal Coliform and *E. coli*
City of Capitola, Santa Cruz County	Noble Gulch at Soquel Creek	Monthly	12[2]	Fecal Coliform and *E. coli*
City of Capitola, Santa Cruz County	Noble Gulch at Victory Lane/Coyote Canyon	Monthly	12[2]	Fecal Coliform and *E. coli*
STORM WATER MONITORING				
City of Capitola and Santa Cruz County	Monterey Ave. (previously sampled CWC station)	Dry Season[3]	5[4]	Fecal Coliform and *E. coli*
		Wet Season[5]	5[4]	
City of Capitola and Santa Cruz County	To be determined[6]	Dry Season[3]	5[4]	Fecal Coliform and *E. coli*
		Wet Season[5]	5[4]	
City of Capitola and Santa Cruz County	To be determined[6]	Dry Season[3]	5[4]	Fecal Coliform and *E. coli*
		Wet Season[5]	5[4]	
City of Capitola and Santa Cruz County	To be determined[6]	Dry Season[3]	5[4]	Fecal Coliform and *E. coli*
		Wet Season[5]	5[4]	
City of Capitola and Santa Cruz County	To be determined[6]	Dry Season[3]	5[4]	Fecal Coliform and *E. coli*
		Wet Season[5]	5[4]	

[1] Grab Sample
[2] One sample must be drawn in a 30-day period within the sampling period
[3] Dry season is June through August
[4] Five samples must be drawn in a 30-day period within each sampling period
[5] Wet season is November through February
[6] Sampling site will be determined by the County of Santa Cruz and the City of Capitola and approved by the Executive Officer of the Regional Water Board

Landowner monitoring for bacteria will provide information for this TMDL. Landowners have the option of performing individual monitoring or participating in a cooperative monitoring program. Individual landowner monitoring can comprise either water quality monitoring or other forms of monitoring (such as a report documenting visual site inspections supported by site photos). Water Board staff will review data every three years to determine compliance with the TMDL. If the executive officer determines additional monitoring is needed, he shall request it pursuant to Section 13267 of the California Water Code.

11.3. Reporting

The Water Board will issue a Water Code Section 13267 letter to the parties responsible for receiving water monitoring and implementation reporting described in Table 10-1. Section 13267 states the Water Board may investigate water quality and the Water Board may require suspected dischargers to furnish monitoring program reports.

The parties responsible for implementation and monitoring will incorporate the results of monitoring efforts in reports filed pursuant to the WDR, Small MS4 Stormwater Permit, Nonpoint Source Implementation Program, or other correspondence as requested by the Water Board pursuant to California Water Code Section 13267.

If reporting changes become necessary based on staff's assessment of the TMDL implementation progress, the Executive Officer or the Water Board will require such changes. At a minimum, the Water Board will evaluate monitoring reporting data and implementation reporting information every three years.

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